

THE PICTURE OF THE TAOIST GENII PRINTED ON THE COVER of this book is part of a painted temple scroll, recent but traditional, given to Mr Brian Harland in Szechuan province (1946). Concerning these four divinities, of respectable rank in the Taoist bureaucracy, the following particulars have been handed down. The title of the first of the four signifies 'Heavenly Prince', that of the other three 'Mysterious Commander'.

At the top, on the left, is Liu *Thien Chün*, Comptroller-General of Crops and Weather. Before his deification (so it was said) he was a rain-making magician and weather forecaster named Liu Chün, born in the Chin dynasty about +340. Among his attributes may be seen the sun and moon, and a measuring-rod or carpenter's square. The two great luminaries imply the making of the calendar, so important for a primarily agricultural society, the efforts, ever renewed, to reconcile celestial periodicities. The carpenter's square is no ordinary tool, but the gnomon for measuring the lengths of the sun's solstitial shadows. The Comptroller-General also carries a bell because in ancient and medieval times there was thought to be a close connection between calendrical calculations and the arithmetical acoustics of bells and pitch-pipes.

At the top, on the right, is Wên *Yuan Shuai*, Intendant of the Spiritual Officials of the Sacred Mountain, Thai Shan. He was taken to be an incarnation of one of the Hour-Presidents (*Chia Shen*), i.e. tutelary deities of the twelve cyclical characters (see Vol. 4, pt. 2, p. 440). During his earthly pilgrimage his name was Huan Tzu-Yü and he was a scholar and astronomer in the Later Han (b. +142). He is seen holding an armillary ring.

Below, on the left, is Kou *Yuan Shuai*, Assistant Secretary of State in the Ministry of Thunder. He is therefore a late emanation of a very ancient god, Lei Kung. Before he became deified he was Hsin Hsing, a poor woodcutter, but no doubt an incarnation of the spirit of the constellation Kou-Chhen (the Angular Arranger), part of the group of stars which we know as Ursa Minor. He is equipped with hammer and chisel.

Below, on the right, is Pi *Yuan Shuai*, Commander of the Lightning, with his flashing sword, a deity with distinct alchemical and cosmological interests. According to tradition, in his early life he was a countryman whose name was Thien Hua. Together with the colleague on his right, he controlled the Spirits of the Five Directions.

Such is the legendary folklore of common men canonised by popular acclamation. An interesting scroll, of no great artistic merit, destined to decorate a temple wall, to be looked upon by humble people, it symbolises something which this book has to say. Chinese art and literature have been so profuse, Chinese mythological imagery so fertile, that the West has often missed other aspects, perhaps more important, of Chinese civilisation. Here the graduated scale of Liu Chün, at first sight unexpected in this setting, reminds us of the ever-present theme of quantitative measurement in Chinese culture; there were rain-gauges already in the Sung (+12th century) and sliding calipers in the Han (+1st). The armillary ring of Huan Tzu-Yü bears witness that Naburiannu and Hipparchus, al-Naqqāsh and Tycho, had worthy counterparts in China. The tools of Hsin Hsing symbolise that great empirical tradition which informed the work of Chinese artisans and technicians all through the ages.

SCIENCE AND CIVILISATION IN CHINA

Glaubt ihr denn, daß die Wissenschaften entstanden und groß geworden wären, wenn ihnen nicht Zauberer, Alchimisten, Astrologen und Hexen vorangelaufen wären als die, welche erst Durst, Hunger und Wohlgeschmack an verborgenen und verbotenen Mächten schaffen mußten?

(Do you believe then that the sciences would ever have arisen and become great if there had not beforehand been magicians, alchemists, astrologers and wizards, who thirsted and hungered after abscondite and forbidden powers?)

FRIEDRICH NIETZSCHE

'Die fröhliche Wissenschaft', IV, 1886.

Occupé depuis longtemps de l'histoire de la chimie, nous voyons clairement aujourd'hui les difficultés auxquelles s'expose celui qui entreprendra de l'écrire. Une connaissance approfondie de la science sera loin de lui suffire, s'il n'a pas recours aux lumières de la littérature ancienne et de la littérature orientale.

(Having long been occupied with the history of chemistry, we can clearly see today what difficulties lie in the path of anybody who undertakes to write it. A deep knowledge of the science itself will not suffice unless he has recourse to the ancient, and to the oriental, literature.)

MICHEL EUGÈNE CHEVREUL (1786 to 1889)

reviewing Reinaud & Favé in

Journal des Savants, 1847, p. 219.

Seek for knowledge, even though it be as far away as China.

Veritable saying (*ḥadīth*) of the Prophet

Muḥammad

(al-Suhrawardy, no. 273).

李約瑟著

中國科學技術史

冀朝鼎



SCIENCE AND CIVILISATION IN CHINA

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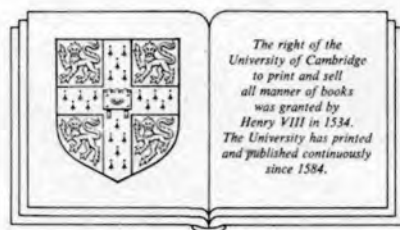
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VOLUME 5

CHEMISTRY AND CHEMICAL TECHNOLOGY

PART II: SPAGYRICAL DISCOVERY AND INVENTION: MAGISTERIES OF GOLD AND IMMORTALITY



CAMBRIDGE UNIVERSITY PRESS

CAMBRIDGE

NEW YORK PORT CHESTER

MELBOURNE SYDNEY

Published by the Press Syndicate of the University of Cambridge
The Pitt Building, Trumpington Street, Cambridge CB2 1RP
40 West 20th Street, New York, NY 10011, USA
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

© Cambridge University Press 1974

First published 1974
Reprinted 1985, 1990

Library of Congress Catalogue Card Number: 54-4723

ISBN 0 521 08571 3

Printed in Great Britain at the
University Press, Cambridge

To two comrades-in-arms in an age-long struggle,
The use of natural knowledge for peace and love,
Not in the service of hatred and war,

This volume is dedicated:

THANG PHEI-SUNG

Professor of Plant Biochemistry at Chhinghua University, Peking
author of *Green Thralldom*
proponent of food for the world,
—remembering the war-time laboratory among the hills of Tapuchi—

年 年 清 喜

and

J. DESMOND BERNAL

sometime Professor of Crystallography at Birkbeck College, London
author of *Science in History*
and the *Social Function of Science*

Of Loyolan subtlety in Ireland bred
Three enemies of man he re-interpreted;
Saw world, flesh, devil, black-rob'd walk their rounds
And love's two friends advance a banner red.

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LIST OF ABBREVIATIONS

The following abbreviations are used in the text and footnotes. For abbreviations used for journals and similar publications in the bibliographies, see pp. 306 ff.

- B Bretschneider, E. (1), *Botanicon Sinicum*.
- CC Chia Tsu-Chang & Chia Tsu-Shan (1), *Chung-Kuo Chih Wu Thu Chien* (Illustrated Dictionary of Chinese Flora), 1958.
- CCIF Sun Ssu-Mo, *Chhien Chin I Fang* (Supplement to the Thousand Golden Remedies), c. +660.
- CHS Pan Ku (and Pan Chao), *Chhien Han Shu* (History of the Former Han Dynasty), c. +100.
- CLPT Thang Shen-Wei *et al.* (ed.), *Chéng Lei Pén Tshao* (Reorganised Pharmacopoeia), ed. of +1249.
- CSHK Yen Kho-Chün (ed.), *Chhüan Shang-ku San-Tai Chhin Han San-Kuo Liu Chhao Wên* (Complete Collection of prose literature (including fragments) from remote antiquity through the Chhin and Han Dynasties, the Three Kingdoms, and the Six Dynasties), 1836.
- CTPS Fu Chin-Chhüan (ed.), *Chéng Tao Pi Shu Shih Chung* (Ten Types of Secret Books on the Verification of the Tao), early 19th cent.
- HFT Han Fei, *Han Fei Tzu* (Book of Master Han Fei), early -3rd cent.
- HNT Liu An *et al.*, *Huai Nan Tzu* (Book of the Prince of Huai-Nan), -120.
- ICK Taki Mototane, *I Chi Khao (Iseki-kô)* (Comprehensive Annotated Bibliography of Chinese Medical Literature [Lost or Still Existing]), finished c. 1825, pr. 1831; repr. Tokyo 1933, Shanghai 1936.
- K Karlgren, *Grammata Serica* (dictionary giving the ancient forms and phonetic values of Chinese characters).
- KHTT Chang Yü-Shu (ed.), *Khang-Hsi Tzu Tien* (Imperial Dictionary of the Khang-Hsi reign-period), +1716.
- Kr Kraus, P. *Le Corpus des Écrits Jābiriens (Mémoires de l'Institut d'Égypte)* 1943, vol. 44, pp. 1-214).
- LPC Lung Po-Chien (1), *Hsien Tshun Pén Tshao Shu Lu* (Bibliographical Study of Extant Pharmacopoeias and Treatises on Natural History from all Periods).
- MCPT Shen Kua, *Méng Chhi Pi Than* (Dream Pool Essays), +1089.
- N Nanjio, B., *A Catalogue of the Chinese Translations of the Buddhist Tripiṭaka*, with index by Ross (3).
- PPT/NP Ko Hung, *Pao Phu Tzu (Nei Phien)* (Book of the Preservation-of-Solidarity Master; Inner Chapters), c. +320.
- PTKM Li Shih-Chen, *Pén Tshao Kang Mu* (The Great Pharmacopoeia), +1596.

- R Read, Bernard E. *et al.*, Indexes, translations and précis of certain chapters of the *Pên Tshao Kang Mu* of Li Shih-Chen. If the reference is to a plant see Read (1), if to a mammal, see Read (2); if to a bird see Read (3); if to a reptile see Read (4 or 5); if to a mollusc see Read (5); if to a fish see Read (6); if to an insect see Read (7).
- RP Read & Pak (1), Index, translation and précis of the mineralogical chapters in the *Pên Tshao Kang Mu*.
- SC Ssuma Chhien, *Shih Chi* (Historical Records), c. — 90.
- SF Thao Tsung-I (ed.), *Shuo Fu* (Florilegium of (Unofficial) Literature), c. +1368.
- SHC *Shan Hai Ching* (Classic of the Mountains and Rivers), Chou and C/Han.
- SIC Okanishi Tameto, *Sung I-Chhien I Chi Khao* (Comprehensive Annotated Bibliography of Chinese Medical Literature in and before the Sung Period). Jen-min Wei-shêng, Peking, 1958.
- SKCS *Ssu Khu Chhüan Shu* (Complete Library of the Four Categories), +1782; here the reference is to the *tshung-shu* collection printed as a selection from one of the seven imperially commissioned MSS.
- SNPTC *Shen Nung Pên Tshao Ching* (Classical Pharmacopoeia of the Heavenly Husbandman), C/Han.
- SSIW Toktaga (Tho-Tho) *et al.*; Huang Yü-Chi *et al.* & Hsü Sung *et al.* *Sung Shih I Wên Chih, Pu, Fu Phien* (A Conflation of the Bibliography and Appended Supplementary Bibliographies of the History of the Sung Dynasty). Com. Press, Shanghai, 1957.
- TKKW Sung Ying-Hsing, *Thien Kung Khai Wu* (The Exploitation of the Works of Nature), +1637.
- TPHMF *Thai-Phing Hui Min Ho Chi Chü Fang* (Standard Formularies of the (Government) Great Peace People's Welfare Pharmacies), +1151.
- TPYL Li Fang (ed.), *Thai-Phing Yü Lan* (the Thai-Phing reign-period (Sung) Imperial Encyclopaedia), +983.
- TSCC Chhen Mêng-Lei *et al.* (ed.), *Thu Shu Chi Chhêng* (the Imperial Encyclopaedia of +1726). Index by Giles, L. (2).
- TSCCIW Liu Hsü *et al.* & Ouyang Hsiu *et al.*; *Thang Shu Ching Chi I Wên Ho Chih*. A conflation of the Bibliographies of the *Chiu Thang Shu* by Liu Hsü (H/Chin, +945) and the *Hsin Thang Shu* by Ouyang Hsiu & Sung Chhi (Sung, +1061). Com. Press, Shanghai, 1956.
- TT Wieger, L. (6), *Taoïsme*, vol. 1, Bibliographie Générale (catalogue of the works contained in the Taoist Patrology, *Tao Tsang*).
- TTCY Ho Lung-Hsiang & Phêng Han-Jan (ed.). *Tao Tsang Chi Yao* (Essentials of the Taoist Patrology), pr. 1906.
- TW Takakusu, J. & Watanabe, K., *Tables du Taishō Issaikyō* (nouvelle édition (Japonaise) du Canon bouddhique chinoise), Index-catalogue of the Tripiṭaka.

- WCTY/CC* Tsêng Kung-Liang (ed.), *Wu Ching Tsung Yao (Chhien Chi)*, military encyclopaedia, first section, + 1044.
- YCCC* Chang Chün-Fang (ed.), *Yün Chi Chhi Chhien* (Seven Bamboo Tablets of the Cloudy Satchel), Taoist collection, + 1022.
- YHL* Thao Hung-Ching (attrib.), *Yao Hsing Lun* (Discourse on the Natures and Properties of Drugs).
- YHSF* Ma Kuo-Han (ed.), *Yü Han Shan Fang Chi I Shu* (Jade-Box Mountain Studio collection of (reconstituted and sometimes fragmentary) Lost Books), 1853.

ACKNOWLEDGEMENTS

LIST OF THOSE WHO HAVE KINDLY READ THROUGH SECTIONS IN DRAFT

The following list, which applies only to Vol. 5, pts 2-5, brings up to date those printed in Vol. 1, pp. 15 ff., Vol. 2, p. xxiii, Vol. 3, pp. xxxix ff., Vol. 4, pt. 1, p. xxi, Vol. 4, pt. 2, p. xli and Vol. 4, pt. 3, pp. xlii ff.

Prof. Derk Bodde (Philadelphia)	Introductions.
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Prof. A. F. P. Hulsey (Leiden)	Theories.
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Mr Robert Somers (New Haven, Conn.)	Theories.
Dr Michel Strickmann (Kyoto)	Theories.
Dr Mikuláš Teich (Cambridge)	Introductions.
Mr R. G. Wasson (Danbury, Conn.)	Introduction (ethno-mycology).
Mr James Zimmerman (New Haven, Conn.)	Theories.

AUTHOR'S NOTE

IT is now nearly a dozen years since the preface for Vol. 4 of this series (Physics and Physical Technology) was written; since then much has been done towards the later volumes. We are now happy to be able to present a substantial part of Vol. 5 (Spagyric Discovery and Invention), i.e. alchemy and early chemistry, which go together with the arts of peace and war, including military and textile technology, mining, metallurgy and ceramics. The point of this arrangement was explained in the preface of Vol. 4 (e.g. pt. 3, p. 1). Exigences not of logic but of collaboration are making it obligatory that these other topics should follow rather than precede the central theme of chemistry, which here is published as Vol. 5, parts 2, 3, 4 and 5, leaving parts 1 and 6 to appear at a later date.

The number of physical volumes (parts) which we are now producing may give the impression that our work is enlarging according to some form of geometrical progression or along some exponential curve, but this would be largely an illusion, because in response to the reactions of many friends we are now making a real effort to publish in books of less thickness, more convenient for reading. At the same time it is true that over the years the space required for handling the history of the diverse sciences in Chinese culture has proved singularly unpredictable. One could (and did) at the outset arrange the sciences in a logical spectrum (mathematics—astronomy—geology and mineralogy—physics—chemistry—biology) leaving estimated room also for all the technologies associated with them; but to foresee exactly how much space each one would claim, that, in the words of the Jacobite blessing, was 'quite another thing'. We ourselves are aware that the disproportionate size of some of our Sections may give a mis-shapen impression to minds enamoured of classical uniformity, but our material is not easy to 'shape', perhaps not capable of it, and appropriately enough we are constrained to follow the Taoist natural irregularity and surprises of a romantic garden rather than to attempt any compression of our lush growths within the geometrical confines of a Cartesian parterre. The Taoists would have agreed with Richard Baxter that 'tis better to go to heaven disorderly than to be damned in due order'. By some strange chance our spectrum meant (though I thought at the time that the mathematics was particularly difficult) that the 'easier' sciences were going to come first, those where both the basic ideas and the available source-materials were relatively clear and precise. As we proceeded, two phenomena manifested themselves: first, the technological achievements and amplifications proved far more formidable than expected (as was the case in Vol. 4, pts. 2 and 3); and secondly, we found ourselves getting into ever deeper water, as the saying is, intellectually (as will fully appear in the Sections on medicine in Vol. 6).

Alchemy and early chemistry, the central subjects of the present volume, exemplified the second of these difficulties well enough, but they have had others of their own. At one time I almost despaired of ever finding our way successfully through the inchoate

mass of ideas, and the facts so hard to establish, relating to alchemy, chemistry, metallurgy and chemical industry in ancient, medieval and traditional China. The facts indeed were much more difficult to ascertain, and also more perplexing to interpret, than anything encountered in subjects such as astronomy or civil engineering. And in the end, one must say, we did not get through without cutting great swathes of briars and bracken, as it were, through the muddled thinking and confused terminology of the traditional history of alchemy and early chemistry in the West. Here it was indispensable to distinguish alchemy from proto-chemistry and to introduce words of art such as aurifiction, aurifaction and macrobiotics. It is also fair to say that the present subject has been far less well studied and understood either by Westerners or Chinese scholars themselves than fields like astronomy and mathematics, where already in the eighteenth century a Gaubil could do outstanding work, and nearer our own time a Chhen Tsun-Kuei, a de Saussure, and a Mikami Yoshio could set them largely in order. If the study of alchemy and early chemistry had advanced anything like so far, it would be much easier today than it actually is to differentiate with clarity between the many divergent schools of alchemists at the many periods, from the -3rd century to the +17th, with which we have to deal. More adequate understanding would also have been achieved with regard to that crucial Chinese distinction between inorganic laboratory alchemy and physiological alchemy, the former concerned with elixir preparations of mineral origin, the latter rather with operations within the adept's own body; a distinction hardly realised to the full in the West before the just passed decade. As we shall show in these volumes, there was a synthesis of these two age-old trends when in iatro-chemistry from the Sung onwards laboratory methods were applied to physiological substances, producing what we can only call a proto-biochemistry. But this will be read in its place.

Now a few words on our group of collaborators. Dr Ho Ping-Yü,¹ since 1961 Professor of Chinese at the University of Malaya, Kuala Lumpur, was introduced to readers in Vol. 4, pt. 3, p. lv; here he has been responsible for drafting the major part of the sub-section on the history of alchemy in China. Dr Lu Gwei-Djen,² my oldest collaborator, dating (in historian's terms) from 1937, has been involved at all stages of the present volumes, especially in that seemingly endless mental toil of ours which resulted in the introductory sub-sections on concepts, definitions and terminology, with all that that implies for theories of alchemy, ideas of immortality, and the physiological pathology of the elixir complex. But her particular domain has been that of physiological alchemy, and it was her discoveries, just at the right moment, of what was meant by the three primary vitalities, mutationist inversion, counter-current flow, and such abstruse matters, which alone permitted the unravelling, at least in the provisional form here presented (in the relevant sub-section *j*), of that strange and unfamiliar system, quasi-Yogistic perhaps, but full of interest for the pre-history of biochemical thought.³ A third collaborator is now to be welcomed for the first time,

³ Some of her findings have appeared separately (Lu Gwei-Djen, 2).

¹ 何丙郁

² 魯桂珍

Dr Nathan Sivin, Professor at the Massachusetts Institute of Technology, who has contributed the sub-section on the general theory of elixir alchemy.

Although Prof. Sivin has helped the whole group much by reading over and suggesting emendations for all the rest, it is needful to make at this point a proviso which has not been required in previous volumes. This is that my collaborators cannot take a collective responsibility for statements, translations or even general nuances, occurring in parts of the book other than that or those in which they each themselves directly collaborated. All incoherences and contradictions which remain after our long discussions must be laid at my door, in answer to which I can only say that the state of the art is as yet very imperfect, that it will certainly be improved by later scholars, and that in the meantime we have done the best we can. If fate had granted to the four of us the possibility of all working together in one place for half-a-dozen years, things could have been rather different, but in fact Prof. Ho and Prof. Sivin were never even in Cambridge at one and the same time. Thus these volumes have come into existence the hard way, drafted by different hands at fairly long intervals of time, and still no doubt containing traces of various levels of sophistication of understanding. Indeed it would have been reasonable to mark the elixir theory sub-section 'by Nathan Sivin', rather than 'with Nathan Sivin', if it had not been for the fact that some minor embroideries were offered by me, and that a certain part of it, not perhaps the least interesting, is a revised version of a memoir by Ho Ping-Yü and myself first published in 1959. Lacking the unities of time and place, complete credal unity, as it were, has been unattainable, but that does not mean that we are not broadly at one over the main facts and problems of the field as a whole; so that rightly we may be called co-workers.

Besides this I am eager to make certain further acknowledgements. During the second world war I was instrumental in securing for Cambridge copies of the *Tao Tsang* and the *Tao Tsang Chi Yao*. At a somewhat later time (1951-5) Dr Tshao Thien-Chhin,¹ then a Fellow of Caius, made a most valuable pioneer study of the alchemical books in the Taoist Patrology, using a microfilm set in our working collection (now the East Asian History of Science Library, an educational Trust). After his return to the Biochemical Institute of Academia Sinica, Shanghai, of which he has been in recent years Vice-Director, these notes were of great help to Dr Ho and myself, forming the ultimate basis for another sub-section, that on aqueous reactions. Secondly, when we were faced with the fascinating but difficult study of the evolution of chemical apparatus in East and West, Dr Dorothy Needham put in a considerable amount of work, including some drafting, in what happened to be a convenient interval in work on her own book on the history of muscle biochemistry, *Machina Carnis*. She has also read all our pages—perhaps the only person in the world who ever does so!

While readers of sub-sections in typescript and proof have not been as numerous, perhaps, as for previous volumes, a special debt of gratitude is due to Mr J. A. Charles of St John's College, chemist, metallurgist and archaeologist, whose advice to Prof. Ho and myself from the earliest days has been extremely precious. Valuable consultations

¹ 曹天欽

also took place with Mr H. J. Sheppard of Warwick, especially during his time in Cambridge as a Schoolmaster-Fellow of Churchill College. Few chemists in Cambridge, by some chance, happen to be interested at the present time in the history of their subject, but if Dr A. J. Berry and Prof. J. R. Partington had lived we could have profited greatly from their help. With the latter, indeed, we did have fruitful and most friendly contact, but it was in connection mainly with the gunpowder epic, Prof. Wang Ling¹ and I endeavouring, not unsuccessfully, to convince him of the real and major contribution of China in that field; those were days however before any word of the present volume had been written. In 1968, well after it had started, there was convened the First Conference of Taoist Studies at the Villa Serbelloni at Bellagio on Lake Como; Ho Ping-Yü, Nathan Sivin and myself were all of the party, and here much stimulus was obtained from that remarkable *Tao shih* Kristofer Schipper—hence the unexpected sub-section on liturgiology and alchemical origins in our introductory material. In addition to the invaluable advice of many other colleagues in special areas, Dr N. Sivin desires us to note the kindness of Prof. Cyril Stanley Smith in commenting upon the whole sub-section on the theory of elixir alchemy. He also expresses his gratitude to Prof. A. F. P. Hulsewé and his staff for the open-hearted hospitality which they gave him during the gestation of that study, carried out almost entirely at the Sinologisch Instituut, Leiden.

It is right to record that certain parts of these volumes have been given as lectures to bodies honouring us by such invitations. Thus various excerpts from the introductory sub-sections, on concepts, terminology and definitions, were given for the Rapkine Lecture at the Pasteur Institute in Paris (1970) and the Bernal Lecture at Birkbeck College in London in the following year. Portions of the historical sub-sections, especially that on the coming of modern chemistry, were used for the Ballard Matthews Lectures of the University of Wales at Bangor. A considerable part of the physiological alchemy material formed the basis of the Fremantle Lectures at Balliol College, Oxford,^a and had been given more briefly as the Harvey Lecture to the Harveian Society of London the year before.

If there is one question more than any other raised by this present Section 33 on alchemy and early chemistry, now offered to the republic of learning in these volumes, it is that of human unity and continuity. In the light of what is here set forth, can we allow ourselves to visualise that some day before long we shall be able to write the history of man's enquiry into chemical phenomena as one single development throughout the Old World cultures? Granted that there were several different foci of ancient metallurgy and primitive chemical industry, how far was the gradual flowering of alchemy and chemistry a single endeavour, running contagiously from one civilisation to another?

It is a commonplace of thought that some forms of human experience seem to have progressed in a more obvious and palpable way than others. It might be difficult to

^a The relevant volume is therefore offered to the Trustees of the late Sir Francis Fremantle's benefaction in discharge of the duty of publication of his Lectures (1971).

¹ 王鈴

say how Michael Angelo could be considered an improvement on Pheidias, or Dante on Homer, but it can hardly be questioned that Newton and Pasteur and Einstein did really know a great deal more about the natural universe than Aristotle or Chang Hêng. This must tell us something about the differences between art and religion on one side and science on the other, though no one seems able to explain quite what, but in any case within the field of natural knowledge we cannot but recognise an evolutionary development, a real progress, over the ages. The cultures might be many, the languages diverse, but they all partook of the same quest.

Throughout this series of volumes it has been assumed all along that there is only one unitary science of Nature, approached more or less closely, built up more or less successfully and continuously, by various groups of mankind from time to time. This means that one can expect to trace an absolute continuity between the first beginnings of astronomy and medicine in Ancient Babylonia, through the advancing natural knowledge of medieval China, India, Islam and the classical Western world, to the break-through of late Renaissance Europe when, as has been said, the most effective method of discovery was itself discovered. Many people probably share this point of view, but there is another one which I may associate with the name of Oswald Spengler, the German world-historian of the thirties whose works, especially *The Decline of the West* (1), achieved much popularity for a time. According to him, the sciences produced by different civilisations were like separate and irreconcilable works of art, valid only within their own frames of reference, and not subsumable into a single history and a single ever-growing structure.

Anyone who has felt the influence of Spengler retains, I think, some respect for the picture he drew of the rise and fall of particular civilisations and cultures, resembling the birth, flourishing and decay of individual biological organisms, in human or animal life-cycles. Certainly I could not refuse all sympathy for a point of view so like that of the Taoist philosophers, who always emphasised the cycles of life and death in Nature, a point of view that Chuang Chou himself might well have shared. Yet while one can easily see that artistic styles and expressions, religious ceremonies and doctrines, or different kinds of music, have tended to be incommensurable; for mathematics, science and technology the case is altered—man has always lived in an environment essentially constant in its properties, and his knowledge of it, if true, must therefore tend towards a constant structure.

This point would not perhaps need emphasis if certain scholars, in their anxiety to do justice to the differences between the ancient Egyptian or the medieval Chinese, Arabic or Indian world-views and our own, were not sometimes tempted to follow lines of thought which might lead to Spenglerian pessimism.^a Pessimism I say, because

^a Just recently a relevant polemical discussion has been going on among geologists. Harrington (1, 2), who had traced interesting geological insights in Herodotus and Isaiah, was taken to task by Gould (1), maintaining that 'science is no march to truth, but a series of conceptual schemes each adapted to a prevailing culture', and that progress consists in the mutation of these schemes, new concepts of creative thinkers resolving anomalies of old theories into new systems of belief. This was evidently a Kuhnian approach, but no such formulation will adequately account for the gradual percolation of true knowledge through the successive civilisations, and its general accumulation. Harrington himself, in his reply (3), maintained that 'there is a singular state of Nature towards which all estimates of reality

of course he did prophesy the decline and fall of modern scientific civilisation. For example, our own collaborator, Nathan Sivin, has often pointed out, quite rightly, that for medieval and traditional China 'biology' was not a separated and defined science. One gets its ideas and facts from philosophical writings, books on pharmaceutical natural history, treatises on agriculture and horticulture, monographs on groups of natural objects, miscellaneous memoranda and so on. He urged that to speak without reservations of 'Chinese biology' would be to imply a structure which historically did not exist, disregarding mental patterns which did exist. Taking such artificial rubrics too seriously would also imply the natural but perhaps erroneous assumption that medieval Chinese scientists were asking the same questions about the living world as their modern counterparts in the West, and merely chanced, through some quirk of national character, language, economics, scientific method or social structure, to find different answers. On this approach it would not occur to one to investigate what questions the ancient and medieval Chinese scientists themselves were under the impression that they were asking. A fruitful comparative history of science would have to be founded not on the counting up of isolated discoveries, insights or skills meaningful for us now, but upon 'the confrontation of integral complexes of ideas with their interrelations and articulations intact'. These complexes could be kept in one piece only if the problems which they were meant to solve were understood. Chinese science must, in other words, be seen as developing out of one state of theoretical understanding into another, rather than as any kind of abortive development towards modern science.

All this was well put; of course one must not see in traditional Chinese science simply a 'failed prototype' of modern science, but the formulation here has surely to be extremely careful. There is a danger to be guarded against, the danger of falling into the other extreme, and of denying the fundamental continuity and universality of all science. This could be to resurrect the Spenglerian conception of the natural sciences of the various dead (or even worse, the living) non-European civilisations as totally separate, immiscible thought-patterns, more like distinct works of art than anything else, a series of different views of the natural world irreconcilable and unconnected. Such a view might be used as the cloak of some historical racist doctrine, the sciences of pre-modern times and the non-European cultures being thought of as wholly conditioned ethnically, and rigidly confined to their own spheres, not part of humanity's broad onward march. Moreover, it would leave little room for those actions and reactions that we are constantly encountering, deep-seated influences which one civilisation had upon another.

In a different place Nathan Sivin has written: 'The question of why China never spontaneously experienced the equivalent of our scientific revolution lies of course very close to the core of a comparative history of science. My point is that it is an utter

converge', and therefore that we can and should judge the insights of the ancients on the basis of our own knowledge of Nature, while at the same time making every effort to understand their intellectual framework. In illustration he took the medieval Chinese appreciation of the meaning of fossil remains (cf. Vol. 3, pp. 611 ff.). We are indebted to Prof. Claude Albritton of Texas for bringing this discussion to our notice.

waste of time, and distracting as well, to expect any answer until the Chinese tradition has been adequately comprehended from the inside.' The matter could not be better put; we must of course learn to see instinctively through the eyes of those who thought in terms of the Yin and Yang, the Five Elements, the symbolic correlations, and the trigrams and hexagrams of the *Book of Changes*. But here again this formulation might suggest a purely internalist or ideological explanation for the failure of modern natural science to arise in Chinese culture. I don't think that in the last resort we shall be able to appeal primarily to inhibiting factors inherent in the Chinese thought-world considered as an isolated Spenglerian cell. One must always expect that some of these intellectual limiting factors will be identifiable, but for my part I remain sceptical that there are many factors of this kind which could not have been overcome if the social and economic conditions had been favourable for the development of modern science in China. It may indeed be true that the modern forms of science which would then have developed would have been rather different from those which actually did develop in the West, or in a different order, that one cannot know. There was, for example, the lack of Euclidean geometry and Ptolemaic planetary astronomy in China, but China had done all the ground-work in the study of magnetic phenomena, an essential precursor of later electrical science;^a and Chinese culture was permeated by conceptions much more organic, less mechanistic, than that of the West.^b Moreover Chinese culture alone, as we shall see, perhaps, provided that materialist conception of the elixir of life which, passing to Europe through the Arabs, led to the macrobiotic optimism of Roger Bacon and the iatro-chemical revolution of Paracelsus, hardly less important in the origins of modern science than the work of Galileo and Newton. Whatever the ideological inhibiting factors in the Chinese thought-world may turn out to have been, the certainty always remains that the specific social and economic features of traditional China were connected with them. They were clearly part of that particular pattern, and in these matters one always has to think in terms of a 'package-deal'. In just the same way, of course, it is impossible to separate the scientific achievements of the ancient Greeks from the fact that they developed in mercantile, maritime, city-state democracies.

To sum it up, the failure of China to give rise to distinctively modern science while having been in many ways ahead of Europe for some fourteen previous centuries is going to take some explaining.^c Internalist historiography is likely to encounter grave difficulties here, in my opinion, because the intellectual, philosophical, theological and cultural systems of ideas of the Asian civilisations are not going to be able to take the causal stress and strain required. Some of these idea-systems, in fact, such as Taoism and Neo-Confucianism, would seem to have been much more congruent with modern science than any of the European ones were, including Christian theology. Very likely the ultimate explanations will turn out to be highly paradoxical—aristocratic military feudalism seeming to be much stronger than bureaucratic feudalism but actually

^a See our discussions in Vol. 3 and Vol. 4, pt. 1.

^b This was emphasised in Vol. 2, *passim*.

^c We set forth in a preliminary way what is at issue here in Vol. 3, pp. 150ff. Some 'thinking aloud' done at various times has also been assembled in Needham (65).

weaker because less rational—the monotheism of a personal creator God being able to generate modern scientific thought (as the San Chiao could never do) but not to give it an inspiration enduring into modern times—and so on. We do not yet know.

A similar problem has of late been worrying Said Husain Nasr, the Persian scholar who is making valuable contributions to the history of science in Islam. He, for his part, faces the failure of Arabic civilisation to produce modern science. But far from regretting this he makes a positive virtue of it, rejecting belief in any integral, social-evolutionary development of science. Opening one of his recent books we read as follows:^a

The history of science is often regarded today as the progressive accumulation of techniques and the refinement of quantitative methods in the study of Nature. Such a point of view considers the present conception of science to be the only valid one; it therefore judges the sciences of other civilisations in the light of modern science, and evaluates them primarily with respect to their 'development' with the passage of time. Our aim in this work however, is not to examine the Islamic sciences from the point of view of modern science and of this 'evolutionist' conception of history; it is on the contrary to present certain aspects of the Islamic sciences as seen from the Islamic point of view.

Now Nasr considers that the Sufis and the universal philosophers of medieval Islam sought and found a kind of mystical *gnosis*, or cosmic *sapientia*, in which all the sciences 'knew their place', as it were (like servitors in some great house of old), and ministered to mystical theology as the highest form of human experience. In Islam, then, the philosophy of divinity was indeed the *regina scientiarum*. Anyone with some appreciation of theology as well as science cannot help sympathising to some extent with this point of view, but it does have two fatal drawbacks: it denies the equality of the forms of human experience, and it divorces Islamic natural science from the grand onward-going movement of the natural science of all humanity. Nasr objects to judging medieval science by its outward 'usefulness' alone. He writes:^b 'However important its uses may have been in calendrical computation, in irrigation or in architecture, its ultimate aim always was to relate the corporeal world to its basic spiritual principle through the knowledge of those symbols which unite the various orders of reality. It can only be understood, and should only be judged, in terms of its own aims and its own perspectives.' I would demur. It was part, I should want to maintain, of all human scientific enterprise, in which there is neither Greek nor Jew, neither Hindu nor Han. 'Parthians, Medes and Elamites, and the dwellers in Mesopotamia, and in Judaea and Cappadocia, in Pontus and Asia . . . and the parts of Libya about Cyrene . . . we do hear them speak in our tongues the marvellous works of God.'^c

The denial of the equality of the forms of human experience comes out clearly in another work of Said Husain Nasr (2). Perhaps rather under-estimating the traditional high valuation placed within Christendom upon Nature—'that universal and publick manuscript', as Sir Thomas Browne said,^d 'which lies expans'd unto the eyes of all'—

^a (1), p. 21.

^b (1), pp. 39-40.

^c Acts 2, 1.

^d *Religio Medici* I, xvi. 'Thus there are two Books from whence I collect my Divinity; besides that written one of God, another of his servant Nature. . .'

he sees in the scientific revolution at the Renaissance a fundamental desacralisation of Nature, and urges that only by re-consecrating it, as it were, in the interests of an essentially religious world-view, will mankind be enabled to save itself from otherwise inevitable doom. If the rise of modern science within the bosom of Christendom alone had any causal connections with Christian thought that would give it a bad mark in his view. 'The main reason why modern science never arose in China or Islam', he says,^a

is precisely because of the presence of a metaphysical doctrine and a traditional religious structure which refused to make a profane thing of Nature... Neither in Islam, nor India nor the Far East, was the substance and the stuff of Nature so depleted of a sacramental and spiritual character, nor was the intellectual dimension of these traditions so enfeebled, as to enable a purely secular science of Nature and a secular philosophy to develop outside the matrix of the traditional intellectual orthodoxy... The fact that modern science did not develop in Islam is not a sign of decadence [or incapacity] as some have claimed, but of the refusal of Islam to consider any form of knowledge as purely secular, and divorced from what it conceived to be the ultimate goal of human existence.

These are striking words,^b but are they not tantamount to saying that only in Europe did the clear differentiation of the forms of experience arise? In other terms, Nasr looks for the synthesis of the forms of experience in the re-creation of a medieval world-view, dominated by religion,^c not in the existential activity of individual human beings dominated by ethics. That would be going back, and there is no going back. The scientist must work *as if* Nature was 'profane'. As Giorgio di Santillana has said:^d

Copernicus and Kepler believed in cosmic vision as much as any Muslim ever did, but when they had to face the 'moment of truth' they chose a road which was apparently not that of *sapientia*; they felt they had to state what appeared to be the case, and that on the whole it would be more respectful of divine wisdom to act thus.

And perhaps it is a sign of the weakness of what can only be called so conservative a conception that Nasr is driven to reject the whole of evolutionary fact and theory, both cosmic, biological and sociological.

In meditating on the view of modern physical science as a 'desacralisation of Nature' many ideas and possibilities come to mind, but one very obvious cause for surprise is that it occurred in Christendom, the home of a religion in which an incarnation had sanctified the material world, while it did not occur in Islam, a culture which had never developed a soteriological doctrine.^e This circumstance might offer an

^a (2), p. 97.

^b Views such as this are by no means restricted to Muslim scholars. From within the bosom of Christendom a very similar attitude is to be found in the book on alchemy by Titus Burckhardt (1), cf. esp. pp. 66, 203.

^c It seems very strange to us that he should regard Chinese culture as having been dominated by religion at any time.

^d In his preface to Said Husain Nasr (1), p. xii.

^e This point was made by the Rev. D. Cupitt in discussion following a lecture for the Cambridge Divinity Faculty (1970) in which some of these paragraphs were used. It was afterwards published in part (Needham, 68). The contrast may be to some extent a matter of degree, since Islamic philosophy tended to recognise the material world as an emanation of the divine.

argument in favour of the primacy of social and economic factors in the break-through of the scientific revolution. It may be that while ideological, philosophical and theological differences are never to be undervalued, what mattered most of all were the facilitating pressures of the transition from feudalism to mercantile and then industrial capitalism, pressures which did not effectively operate in any culture other than that of Western, Frankish, Europe.

In another place Nasr wonders what Ibn al-Haitham or al-Bīrūnī or al-Khāzīnī would have thought about modern science. He concludes that they would be amazed at the position which exact quantitative knowledge has come to occupy today. They would not understand it because for them all *scientia* was subordinated to *sapientia*. Their quantitative science was only one interpretation of a segment of Nature, not the means of understanding all of it. "Progressive" science, he says,^a 'which in the Islamic world always remained secondary, has now in the West become nearly everything, while the immutable and "non-progressive" science or wisdom which was then primary, has now been reduced to almost nothing.' It happened that I read these words at a terrible moment in history. If there were any weight in the criticism of the modern scientific world-view from the standpoint of Nasr's perennial Muslim *sapientia* it would surely be that modern science and the technology which it has generated have far outstripped morality in the Western and modern world, and we shudder to think that man may not be able to control it. Probably none of the human societies of the past ever were able to control technology, but they were not faced by the devastating possibilities of today, and the moment I read Nasr's words was just after the Jordanian civil war of September 1970, that dreadful fratricidal catastrophe within the bosom of Islam itself. Since then we have had the further shocking example of Bengali Muslims being massacred by their brothers in religion from the Indus Valley. *Sapientia* did not prevent these things, nor would it seem, from the historical point of view, that wars and cruelties of all kinds have been much less within the realms of Islam or of East Asia than that of Christendom. Modern science, at all events, is not guilty as such of worsening men's lot, on the contrary it has immensely ameliorated it, and everything depends on what use humanity will make of these unimaginable powers for good or evil. Something new is needed to make the world safe for mankind; and I believe that it can and will be found.

In later discussions Nathan Sivin has made it clear that he is just as committed to a universal comparative history of science as any of the rest of us. That would be the ultimate justification of all our work. His point is not that the Chinese (or Indian, or Arabic) tradition should be evaluated only in the light of its own world-view, then being left as a kind of museum set-piece, but that it must be understood as fully as possible in the light of this as a prelude to the making of wide-ranging comparisons. The really informative contrasts, he suggests, are not those between isolated discoveries, but between those whole systems of thought which have served as the matrices of discovery.^b One might therefore agree that not only particular individual anticipations of modern scientific discoveries are of interest as showing the slow

^a (1), p. 145.

^b Cf. Sivin (10).

development of human natural knowledge, but also that we need to work out exactly how the world-views and scientific philosophies of medieval China, Islam or India differed from those of modern science, and from each other. Each traditional system is clearly of great interest not only in itself but in relation to our present-day patterns of ideas. In this way we would not only salute the Chinese recording of sun-spots from the — 1st century,^a or the earliest mention of the flame test for potassium salts by Thao Hung-Ching in the + 5th century, or the first correct explanation of the optics of the rainbow by Qutb al-Dīn al-Shīrāzī in + 1300,^b as distinct steps on the way to modern science, but also take care to examine the integral systems of thought and practice which generated these innovations. Modern science was their common end, but their evolution can only be explained (that is to say, causally accounted for) in the context of the various possibilities opened and closed by the totality of ideas, values and social attitudes of their time.

Section 33(*h*), on the theoretical background of proto-chemical alchemy, may be taken as an exemplification and a test of this way of looking at early science.^c Nathan Sivin's contribution deals with an abstract approach to Nature which has little to do with post-Galilean physical thought. Looking at the aims of the theoretically-minded alchemists as expressed in their own words, they turn out to be concerned with the design and construction of elaborate chemical models of the cyclic Tao of the cosmos which governs all natural change. A multitude of correspondences and resonances inspire the design of these models. One can distinguish as elements in their rationale the archaic belief in the maturation of minerals within the earth, the complex role of time, and the subtle interplay of quantity and numerology in ensuring that the elaboratory would be a microcosmos. Once we have reached at least a rough comprehension of the system which unites these elements, we can apprehend the remarkable culmination envisaged by the Chinese alchemists: to telescope time by reducing the grand overriding cycles of the universe to a compass which would allow of their contemplation by the adept—leading, as we have phrased it, to perfect freedom in perfect fusion with the cosmic order. But in the course of our reconnaissance we gather a rich harvest of ideas worth exploring and comparing with those of other cultures, including those of the modern world—for instance, the notion of alchemy as a quintessentially temporal science, springing from a unique concept of material immortality, a sublime conviction of the possibility of the control of change and decay. And we make a beginning towards understanding how the alchemist's concepts determined the details—the symmetries and innovations of materials, apparatus, and exquisitely phased combustions—of his Work, and how new results were reflected in new theoretical refinements as the centuries passed.

It is no less important to be aware that every anticipatory feature of a pre-modern system of science had its Yin as well as its Yang side, disadvantages as well as advantages. Thus the polar-equatorial system of Chinese astronomy delayed Yü Hsi's recognition of the precession of the equinoxes by six centuries after Hipparchus, but

^a Cf. Vol. 3, p. 435.

^b Cf. Vol. 3, p. 474.

^c Another attempt at this approach, applied to mathematical astronomy, will be found in Sivin (9).

on the other hand it gave to Su Sung an equal priority of time over Robert Hooke in the first application of a clock-drive to an observational instrument; and the mechanisation of a demonstrational one by I-Hsing and Liang Ling-Tsan was no less than a thousand years ahead of George Graham and Thomas Tompion with their orrery of 1706.^a In a similar way, perhaps, the conviction of the existence of material life-elixirs cost the lives of untold numbers of royal personages and high officials no less than of Taoist adepts, but it did lead to the accumulation of a great fund of knowledge about metals and their salts, in the pursuit of which such earth-shaking discoveries as that of gunpowder were incidentally made. So also the ancient idea of urine and other secretions as drugs might easily be written off as 'primitive superstition' if we did not know that it led, by rational if quasi-empirical trains of thought, combined with the use of chemical techniques originally developed for quite different purposes, to the preparation of steroid and protein hormones many centuries before the time of experimental endocrinology and biochemistry.

The only danger in the conception of human continuity and solidarity, as I have outlined it, is that it is very easy to take modern science as the last word, and to judge everything in the past solely in the light of it. This has been justly castigated by Joseph Agassi, who in his lively monograph on the historiography of science (1) satirises the mere 're-arranging of up-to-date science textbooks in chronological order', and the awarding of black and white marks to the scientific men of the past in accordance with the extent to which their discoveries still form part of the corpus of modern knowledge. Of course this Baconian or inductivist way of writing the history of science never did justice to the 'dark side' of Harvey and Newton, let alone Paracelsus, that realm of Hermetic inspirations and idea-sources which can only be regained by us with great difficulty, yet is so important for the history of thought, as the life-work of Walter Pagel has triumphantly shown. One can see immediately that this difficulty is even greater in the case of non-European civilisations, since their thought-world has been even more unfamiliar. Not only so, but the corpus of modern knowledge is changing and increasing every day, and we cannot foresee at all what its aspect will be a century from now. Fellows of the Royal Society like to speak of the 'true knowledge of natural phenomena', but no one knows better than they do how provisional this knowledge is. It is neither independent of the accidents of Western European history, nor is it a final court of appeal for the eschatological judgment of the value of past scientific discoveries, either in West or East. It is a reliable measuring-stick so long as we never forget its transitory nature.

My collaborators and I have long been accustomed to use the image of the ancient and medieval sciences of all the peoples and cultures as rivers flowing into the ocean of modern science. In the words of the old Chinese saying: 'the Rivers pay court to the Sea.'^b In the main this is indubitably right. But there is room for a great deal of difference of opinion on how the process has happened and how it will proceed. One might think of the Chinese and Western traditions travelling substantially the same

^a On all these subjects see Vol. 3 and Vol. 4, pt. 2.

^b *Chhao tsung yü hai*.¹ Cf. Vol. 3, p. 484.

¹ 朝宗于海

path towards the science of today, that science against which, on the inductivist view, all ancient systems can be measured. But on the other hand, as Nathan Sivin maintains, they might have followed, and be following, rather separate paths, the true merging of which lies well in the future. Undoubtedly among the sciences the point of fusion varies, the bar where the river unites at last with the sea. In astronomy and mathematics it took but a short time, in the seventeenth century; in botany and chemistry the process was much slower, not being complete until now, and in medicine it has not happened yet.^a Modern science is not standing still, and who can say how far the molecular biology, the chemistry or the physics of the future will have to adopt conceptions much more organicist than the atomic and the mechanistic which have so far prevailed? Who knows what further developments of the psychosomatic conception in medicine future advances may necessitate? In all such ways the thought-complex of traditional Chinese science may yet have a much greater part to play in the final state of all science than might be admitted if science today was all that science will ever be. Always we must remember that things are more complex than they seem, and that wisdom was not born with us. To write the history of science we have to take modern science as our yardstick—that is the only thing we can do—but modern science will change, and the end is not yet. Here as it turns out is another reason for viewing the whole march of humanity in the study of Nature as one single enterprise. But we must return to the volume now being introduced.

Although the other parts of Vol. 5 are not yet ready for press we should like to make mention of those who are collaborating with us in them. Much of the section on martial technology, for Vol. 5, pt. 1, has been in draft for many years now,^b but it has been held up by delays in the preparation of the extremely important sub-section on the invention of the first chemical explosive known to man, gunpowder, even though all the notes and books and papers necessary for this have long been collected. At present my old collaborator Prof. Wang Ling (Wang Ching-Ning¹), of the Institute of Advanced Studies at Canberra, Australia, is seeing what can be done about this.^c Meanwhile Prof. Lo Jung-Pang,² of the University of California at Davis, spent the winter of 1969–70 in Cambridge, accomplishing not only the sub-section on the history of armour and caparison in China but also the draft of the whole of Section 37 on the salt industry, including the epic development of deep borehole drilling (Vol. 5, pt. 5). About the same time we persuaded Dr Tsien Tsuen-Hsün (Chhien Tshun-Hsün³), the Chinese Librarian at the University of Chicago, to undertake the writing of Section 32 on the great inventions of paper and printing and their development in China; and this is now actively proceeding. For ceramic technology (Section 35) we succeeded

^a This picture has been elaborated elsewhere; Needham (59), reprinted in (64), pp. 396ff.

^b Including an introduction on the literature, a study of close-combat weapons, the sub-sections on archery and ballistic machines, and a full account of iron and steel technology as the background of armament. The first draft of this last has been published as a Newcomen Society monograph; Needham (32), (60).

^c A preliminary treatment of the subject, still, we think, correct in outline, was given in our article in the *Legacy of China* eleven years ago; Needham (47). This has been re-issued in paper-back form.

¹ 王靜寧

² 羅榮邦

³ 錢存訓

in enlisting the collaboration of Miss Margaret Medley, Curator of the Percival David Museum of Chinese porcelain and pottery at the University of London, and this contribution will also be anticipated by many with great interest. Finally non-ferrous metallurgy and textile technology still await their organising genii, for whom abundant notes and documentation have already been collected.

As has so long been customary, we offer our grateful thanks to those who try to keep us 'on the rails' in territory which is not our own: Prof. D. M. Dunlop for Arabic, Dr Charles Sheldon for Japanese, Prof. G. Ledyard for Korean and Prof. Shackleton Bailey for Sanskrit.

Next comes our high secretariat—Miss Muriel Moyle, who continues to give us impeccable indexes; Mrs Liang Chung Lien-Chu¹ (wife of another Fellow of Caius, the physicist Dr Liang Wei-Yao²), who has inserted many a page of well-written characters and made out many a biographical reference-card; and Miss Philippa Hawking, who hews away manfully at translations from the Japanese. We are also happy to acknowledge the skilled and accurate typing help of Mrs Diana Brodie and Mrs Evelyn Beebe, and the editorial work of Mrs Janin Hua Chhang-Ming.³

All that has been said in previous volumes (e.g. Vol. 4, pt. 3, p. lvi) about the University Press, our treasured medium of communication with the world, and Gonville and Caius College, that milieu in which we live and move and have our being, has become only truer as the years go by—their service and their encouragement continue unabated and so does our heartfelt gratitude. If it were not for the devotion of the typographical—and typocritical—masters, and if one could not count on the understanding, kindness and appreciation of one's academic colleagues, nothing of what these volumes represent could ever have come into existence. We have taken pleasure on previous occasions of paying a tribute to our friend Mr Peter Burbidge of the University Press, and this time perhaps we may be allowed to add mention also of our gratitude to Miss Judith Butcher, the amiable Lucina who presided over the monstrous birth of Vol. 4, pt. 3.

As for finance, continuing gratitude is ever due to the Wellcome Trust of London, whose generous support has upheld us throughout the period of preparation of these chemical volumes. Since the history of medicine is touched upon at so many points in them we feel some sense of justification in accepting their unfailing aid. It can hardly be too much emphasised that in China proto-chemistry was elixir alchemy from the very beginning (as it was not in other civilisations of equal antiquity), and by the same token alchemists were very often physicians too (much more so than they tended to be in other civilisations). For the basic elixir notion was a pharmaceutical and therapeutic one, even though its optimism regarding the conquest of death reached a height which modern medical science dare not as yet contemplate. All this will be clarified in what follows. Meanwhile, and lastly, it should be added that Dr N. Sivin wishes to acknowledge financial assistance from the National Science Foundation (U.S.A.) and the Department of Humanities at the Massachusetts Institute of Technology.

¹ 梁鍾蓮杼

² 梁維耀

³ 華昌明

Let us end with a few words of help to the prospective reader, as on previous occasions, offering some kind of waywiser to guide him through those pages of type not always possible to lighten by some memorable illustration. This is not intended as a substitute for the contents-table, the *mu lu*, or as any enlargement of it; but rather as some useful tips of 'inside information' to tell where the really important paragraphs are, and to distinguish them from the supporting detail secondary in significance though often fascinating in itself.

First, then, we would recommend a reader to study very carefully our introduction (Sect. 33*b*) on concepts, terminology and definitions, especially pp. 9-12; because once one has obtained a clear idea of the distinctions between aurifiction, aurifaction and macrobiotics (already referred to, p. xviii above), everything that one encounters in the proto-chemistry and alchemy of all the Old World civilisations falls into place. There is a parallel here with the history of time-keeping, for the radical gap between the clepsydra and the mechanical clock was only filled by half-a-dozen centuries of Chinese hydro-mechanical clockwork. So in the same way the radical gap between Hellenistic aurifictive and aurifactive proto-chemistry at one end, and late Latin alchemy and iatro-chemistry at the other, could only be explained by a knowledge of Chinese chemical macrobiotics.

After that the argument develops in several directions, among which the reader can take his choice. How could belief in aurifaction ever have arisen when the cupellation test had been known almost since the dawn of the ancient empires? Look at 33*b*, 1-2, and especially p. 44. What was the position of China in this respect, and what were the ancient Chinese alchemists probably doing experimentally? Read 33*b*, 3-5; and *c*, 1-8. Why were they so much more occupied with the perpetuation of life on earth, even in ethereal forms, than with the faking or making of gold? We try to explain it in 33*b*, 6. Such an induction of material immortality was indeed the specific characteristic of Chinese alchemy, and our conclusion is that the world-view of ancient China was the only milieu capable of crystallising belief in an elixir (*tan*¹), good against death, as the supreme achievement of the chemist (see esp. pp. 71, 82, 114-15).

This is the nub of the argument, and in later parts (33*i*, 2-3, in Vol. 5, pt. 4) we follow the progress of that great creative dream through Arabic culture into the Latin Baconian and Paracelsian West. Differences of religion, theology and cosmology did not stop its course, but there can be no doubt that it was born within the bosom of the Taoist religion, and hence the reader is invited to participate in a speculation that the alchemist's furnace derived from the liturgical incense-burner no less than from the metallurgical hearth (33*b*, 7, see esp. pp. 127, 154). Finally something is said on the physiological background of the ingestion of elixirs (33*d*, 1, see esp. p. 291); why were they so attractive to the consumer initially and why so lethal later? Here belongs also the perpetual conservation of the body of the adept after death, so important in the Taoist mind in connection with material immortality (33*d*, 2, see esp. pp. 106, 297-8).

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In the sub-section giving the straight historical account of Chinese alchemy from beginning to end, *chi shih pên mo*,¹ as the phrase was (33 *e*, 1-8, in Vol. 5, pt. 3), no part is really more significant than any other. Yet special interest does attach to the oldest firm records of aurification and macrobiotics expounded in (1), and to the study of the oldest alchemical books in (2) and (6, i). The following parts on laboratory apparatus, aqueous reactions, and alchemical theory (all in Vol. 5, pt. 4) explain themselves from the contents table, and again no passage stands out as particularly crucial; unless it were the relation of the Chinese alchemist to time (33 *h*, 3-4). His was indeed the science (or proto-science) of the Change and Decay Control Department, as one might say, for he could (as he believed) accelerate enormously the natural change whereby gold was formed from other substances in the earth, and conversely he could decelerate asymptotically the rate of decay and dissolution that human bodies, each with their ten 'souls' (*hun*² and *pho*³), were normally subject to. Thus in the words of the ancient Chinese slogan (33 *e*, 1) 'gold *can* be made, and salvation *can* be attained'. And the macrobiogens were thus essentially time- and rate-controlling substances—a nobly optimistic concept for a nascent science of two thousand years ago.

Lastly we pass from the 'outer elixir' (*wai tan*⁴) to the 'inner elixir' (*nei tan*⁵), from proto-chemistry to proto-biochemistry, from reliance on mineral and inorganic remedies to a faith in the possibility of making a macrobiogen from the juices and substances of the living body. For this new concept we coin a fourth new word, the enchymoma; its synthesis was in practice the training of mortality itself to put on immortality. This 'physiological alchemy' occupies Vol. 5, pt. 5 (Sect. 33 *j*, 1-8), and the basic ideas may be found in two places, (2) especially (i, ii), and (4). It was not primarily psychological, like the 'mystical alchemy' of the West, though it made much use of meditational techniques, as did the Indian *yogacārya* with which it certainly had connections. Our conclusion is, at the end of (4) and in (8), that most of its procedures were highly conducive to health, both mental and physical, even though its theories embodied much pseudo-science as well as proto-science.

In the end, the iatro-chemistry of the late Middle Ages in China began to apply *wai tan*⁴ laboratory procedures to *nei tan*⁵ materials, bodily secretions, excretions and tissues. Hence arose some extraordinary successes and anticipations (33 *k*, 1-7), but we must not enlarge on them now. And this may suffice for a reader's guide, hoping only that he may fully share with us the excitement and satisfaction of many new insights and discoveries.

¹ 紀事本末² 魂³ 魄⁴ 外丹⁵ 內丹

33. ALCHEMY AND CHEMISTRY

(a) INTRODUCTION: THE HISTORICAL LITERATURE

(1) PRIMARY SOURCES

THE first question which is likely to occur to anyone curious about the ways and means of finding out what China accomplished in the chemical arts and sciences is—what documents do we have? The answer is, a veritable ocean, only a small part of which has yet been charted and explored; and nearly all of this is in printed form. One of the commonest misunderstandings among our friends is that we have to work a great deal with manuscripts (a belief, by the way, not enlightened by the inappropriate title common in certain great libraries: 'Department of Oriental MSS'). In fact, printing in China began so long ahead of Europe, in the +8th and +9th centuries rather than the +15th, that it would almost be true to say that everything in China is either printed or irretrievably lost. There are certain exceptions to this, for example rare finds such as the great MS. library of the Tunhuang cave-temples,^a or personal writings from scholars of the Ming and Ching which have been handed down,^b but broadly speaking the statement is true, and we must have recourse to printed texts.

For alchemy and early chemistry the most important mine is that of the Taoist Patrology, the *Tao Tsang*, which contains literally hundreds of alchemical books and tractates.^c Later on we discuss the role of this great Corpus in the transmission of the Chinese alchemical traditions.^d This is not to say that there are not books important for the present purpose outside the Taoist Patrology, for there are, and we shall come across a good many of them, but they will nearly always have Taoist connections. Where the *Tao Tsang* helps less, however, is in regard to the earliest beginnings, and here nothing can yield in importance to the dynastic histories, many of which, from the *Shih Chi* onwards, give us vital information of unimpeachable historical authority. After this, one must turn to certain genres of literature similar to those which have been already sketched in other contexts,^e here above all the pharmaceutical natural histories or *Pên Tshao* works, ranging from the -2nd century to the end of the +18th.^f Since these were never at any time confined to products and processes of the vegetable kingdom, they furnish precious data on alchemy, chemistry in its quasi-empirical aspects, and chemical industries. Ancillary to these we have the vast medical literature, from which useful sidelights can occasionally be drawn, and then from the +6th century onwards those books which were devoted, more and more elaborately as time went on, to the agricultural and other technologies. Lastly use has to be made

^a Cf. Vol. 1, pp. 126ff.

^b One example of this will be illustrated in the sub-section on modern chemistry in Vol. 5, pt. 3.

^c Cf. Vol. 1, p. 12. Very few of these have as yet, alas, been integrally translated; a list of thirteen is given, with bibliographical details, in Sivin (1), pp. 322 ff., and not all of these are from the *Tao Tsang*.

^d Vol. 5, pt. 3. On pp. 365-7 there will be found a reference list according the *TT* numbers used by us (Wieger (6), vol. 1) with the full titles in Bibliography A.

^e See Vol. 4, pt. 2, pp. 166ff.

^f These will be fully described in Sect. 38 (Vol. 6), but here we discuss them as we draw upon them.

of the encyclopaedic and lexicographic literature, the oldest examples of which take us back to the —3rd century. But still we have not quite exhausted our resources, for through the ages there were produced innumerable books of memorabilia and 'jottings', some of which give highly valuable information rounding out conclusions reached from more official writings; nor must we forget the many novels and other works of fiction which show at any rate what their authors thought likely or possible at their own times.

As is well known, the dating of all such texts is more precisely establishable in Chinese than in any other ancient civilisation, but of course we are not absolutely confined to written texts, for archaeology can considerably assist us. Whether it be the chemical analysis of ancient and medieval dyed or metal objects, or the study of specimens of drugs and chemical substances which have been preserved in tombs and treasuries,^a or the gathering of data from old reliefs and pictures, much help can be gained from this direct approach. And last but not least there is always the ethnographical aspect to remember, for it would be unpardonable if one did not pay any attention to the traditional chemical methods—the distillation of spirits from wine is an obvious example—utilised until now, or very recently, among the Chinese people and their neighbours. This last resource becomes particularly important when one faces the problems of the evolution of chemical apparatus. Thus there are at least three main quarries from which we can dig our materials: the rich abundance of written texts, the direct studies of chemical and iconographic archaeology, and the technical knowledge and skill which the ages have handed down in the cultures of East Asia.

(2) SECONDARY SOURCES

In sketching the gradual progress of understanding of the alchemy and early chemistry of China during the past hundred years or so,^b it will be convenient to make no essential distinction between writings in Western languages and those in Chinese and Japanese, confined though the latter have necessarily been to the ideographic realm. To put the matter in a nutshell, it seems that the conviction of the existence and antiquity of alchemy in China was transmitted very well by Chinese scholars to the pioneer Western sinologists their colleagues in the middle of the last century, but it took far longer for the submissions of the latter to win serious notice from European historians of science, partly because no adequate factual background for them became available until almost our own time. Thus the gist of the matter was already contained in the seminal paper of Edkins (17) on Taoism, written in 1855, from which we quote towards the end of this Section;^c and the same can be said of the memoirs of Martin (2, 3, 8), printed and reprinted between 1868 and 1880. Speaking of aurifaction and the elixir of life, he said: 'If the Chinese are the last to surrender this pleasing illusion, there is good reason to believe that they deserve the more honourable distinction of

^a For a striking example see pp. 160–1.

^b Something on the intimations in the West before this period will be said by way of prefix to the sub-section on comparative studies (Vol. 5, pt. 4).

^c Vol. 5, pt. 5 below.

having been the first to originate the idea.' He then gave a number of brief translations from Chinese texts, not at all well chosen to our eyes, and of course long outdated, but essentially Edkins and Martin were on the right track. However, their papers were published in China, and few in Europe took any notice of them.

The rest of the century was more occupied with the study of Chinese drugs, minerals and chemicals, since no Westerner had the competence to look into the alchemy and early chemistry that can be found in the texts. From 1850 onwards Daniel Hanbury, the pharmaceutical chemist, gave much attention to Chinese inorganic materia medica, including papers on it in his collected volume of 1876, while two years later Geerts (1), working in Japan, brought out a couple of volumes on East Asian knowledge of minerals and metals, based on the literature and providing, like Hanbury, Chinese characters. This approach was continued by de Mély (1) working with Courel, who in 1896 produced an elaborately annotated translation of the chapters on inorganic substances in the *Wakan Sanzai Zue*, Terashima Ryōan's encyclopaedia of +1712 based on the *San Tshai Thu Hui* of a century earlier. Although we must not attempt to follow the parallel developments in the history of Western chemistry, one can hardly fail to note that Berthelot's first work (1) appeared in 1885, while his epoch-making publication of the Greek 'alchemical' (or, as we should say, proto-chemical) Corpus, with Ruelle, followed three years later. He then went on to produce (10) his Latin alchemical texts in 1893, the same year in which appeared the Syriac ones (with Duval) and the Arabic ones (with Houdas). It may go without saying that the older nineteenth-century historians of chemistry such as Hoefer and Kopp knew nothing whatever of Chinese alchemy, but it was perhaps less excusable that China is not even in the index of von Meyer's *History of Chemistry* (1891); he did indeed know of the Alexandrians and the Arabs, but paid little attention to either. Nevertheless some progress was made after the turn of the century, for two otherwise very little-known chemical scholars, Hjortdahl (1) in 1909 and Holgen (1, 2) in 1917, drawing on sinologists such as Chavannes, de Harlez, Wylie and Pelliot, and even learning some Chinese themselves in order to worry out a few paragraphs of the *Pao Phu Tzu* book with the help of friends, wrote two or three remarkably good papers.^a They knew about Li Shao-Chün and Liu An and Wei Po-Yang, they recognised the

^a Here we should also mention the modicum of not inaccurate information that filtered through to Europe about the chemical industries of China. A medical missionary, Porter Smith (1, 2), wrote valuable contributions on these in 1870-1, and from internal evidence one can see that his work was known to Antenorid (1), whose remarkable paper of 1902, though very short, based itself also on Chinese texts in the Royal Library at Berlin, and knew of Ko Hung, and even Liu Hsüan-Chen (the Glauber of China, cf. Vol. 5, pt. 3). Antenorid seems himself to have worked in China. Both these men were ignored, though the latter was just cited, by von Lippmann (see below). Somewhat later, in 1913, a paper on Chinese alchemy was read to the Alchemical Society in London by Chatley (37), brief too, but as well informed as could be expected of a Western engineer then resident in China. This again was ignored by von Lippmann, either because of the war or because he put it down as *Schwärmerei* in the style of A. E. Waite (cf. Vol. 5, pt. 5), one of the pillars of the Society. The information collected by Edkins, Martin and Chatley was at this time (1913-15) debated with some perplexity in that coterie; see Waite (14, 15) and the respective discussions of these papers. What was really needed, said the Chairman (Stanley Redgrove), was that some member or members of the Alchemical Society acquainted with the necessary languages should undertake the study of Chinese and Indian alchemy, and so clear up the whole obscure problem. But as there were no such members matters remained as before.

overwhelming importance of material immortality elixirs rather than aurifaction in ancient China, they suspected that this emphasis transmitted itself to Europe through the Arabic alchemists, and they even knew of the distinction between *wai tan* and *nei tan* though they did not quite understand it. They were partly stimulated by the first edition of P. C. Ray's history of chemistry in India (1902) and felt that 'further Asia' must conceal many things at least as exciting. But it was all to no effect, and the tradition of ignoring the East represented by von Meyer persisted well into the twenties, as one can see in the books of Pattison Muir, Edward Thorpe and Stillman, good though some of these were in their way.

What was worse, the basically correct ideas of the Norwegian and the Netherlander had no influence (though he cited them) upon the greatest and most learned historian of chemistry in the early twentieth century, E. O. von Lippmann, whose famous publication, *Entstehung und Ausbreitung der Alchemie*, appeared in 1919. Since his youth as an industrial sugar chemist in 1878 he had been writing brilliantly on historical subjects in many monographs and collections of papers still usable today. Unfortunately he was a man of prejudices; he 'took against' the part played by China in the history of alchemy and early chemistry,^a and in his relevant discussions^b attempted to rule it out of court. Although these did pay some attention to what contemporary sinologists had been doing, von Lippmann's authorities (Grube instead of Chavannes, for instance) were not the best he could have had; the sketch of Chinese astronomy (based on ignorance and speculation) was inappropriate, and the criticism of legendary datings a work of supererogation since no good sinologist by that time believed in them anyway. But in general von Lippmann took the easy road of portraying everything Chinese as legend, deception and superstition; and profited from a personal acquaintance with the great traveller von Richthofen in his old age to take over from him a suspicion, based on nothing in particular, that no alchemy existed in China until the +8th century when Arabic merchants brought it from the Hellenistic world, and that all relevant documents purporting to be prior to that time had been forged.^c Hence von Lippmann did not quite know what to say about Liu An and Li Shao-Chün, whom he knew vaguely at third hand though not mentioning actually by name. 'The Chinese', wrote von Lippmann, 'possessed no characteristic chemical methods of their own, nor any apparatus of original design', statements the value of which we shall be able to appreciate later on in this volume. The regrettable fact of the matter is that with no personal knowledge of the Chinese language, no awareness that the *Tao Tsang* even existed, no use of the dynastic histories or the pharmaceutical natural histories, and no consciousness of archaeological and ethnographic data, it was painfully presumptuous to entitle a dozen pages 'Chemie und Alchemie in China'. How much better it would have been to say—we just do not yet know.

^a One cannot avoid a certain impression that this attitude may have been connected with the international political situation of the day.

^b Especially (1), pp. 449 ff.

^c This illusion was shared in some moods by Berthelot, who thought (12) that the *Shih Chi* was a fake, and doubted the authenticity of the *Pao Phu Tzu* book. See also, however, (1), pp. 52-3.

Von Lippmann's animus was continued in a number of publications, some posthumous, until as late as 1953,^a strongly influencing writers such as Fierz-David (1). His great successor in England, J. R. Partington, however, was not prepared to follow him in it, and as early as 1927 defended (8a) the authenticity of the *Shih Chi*, the *Huai Nan Tzu* and the *Pao Phu Tzu* books, emphasising their importance for any oecumenical history of chemistry. Of Li Shao-Chün's activities (-133) he remarked that provided the dating could be satisfactorily established, this was before the earliest alchemy known in any other culture. In the following year (9), supported by Bernard Read (11), he declared that 'if Chinese experts can be induced to render some assistance, a new chapter on the transmission of alchemy to the West may soon be written' (8b). Then in 1931 he expressly dissociated himself from the von Lippmann line (8c), deeply criticising the latter's treatment of sources, and telling historians of science for the first time, perhaps, of the treasures of the Taoist Patrology, a pioneer catalogue of which by Wieger (6) had been available already for twenty years. Finally in 1935 Partington saluted the early work of Tenney Davis and his group, which we shall mention in a moment (16), and a couple of years later, in his *Short History of Chemistry* (4), gave a fair and open-minded, though very brief, account of the participation of ancient and medieval China.

During the twenties and thirties, the 'Chinese experts' hoped for by Partington did indeed energetically set to work, though not all of them wrote in languages which would have been comprehensible to him. By 1921 Chang Hung-Chao had completed the first edition of his monumental *Shih Ya* or *Lapidarium Sinicum*, a study of Chinese inorganic knowledge from antiquity onwards, primarily from the mineralogical-metallurgical angle, but still today of the first importance for all workers in the history of chemistry in Chinese culture. Even after half a century an integral translation would still be worth while. From 1918 onwards Wang Chin was publishing an outstanding series of papers on Chinese chemical subjects,^b and from 1920 the Japanese chemist Chikashige Masumi was making similar studies of Chinese alchemy and metallurgical chemistry.^c A book by Nakaseko Rokuro (1927) was followed in 1933 by the first fundamental research into the characteristic chemical apparatus of ancient and medieval China by Tshao Yuan-Yü.^d At the end of the thirties Li Chhiao-Phing produced a well-known book on the history of the Chinese chemical industries which in subsequent editions is still in use.^e Gradually a large secondary literature of Chinese contributions grew up, among which may be mentioned papers by Wang Chin (12), Tsêng Chao-Lun (2) and Wang Chi-Liang & Chi Jen-Jung (1).^f

Meanwhile the Westerners resident in China had not been idle either, and in 1928

^a Notably (16) and (9), vol. 2, p. 81.

^b These were collected in one volume in 1955.

^c An English translation of his book appeared in 1936 and was for many years, with Johnson's (see just below), one of the two chief works on the subject.

^d An abridged translation was produced soon afterwards by Barnes (1).

^e The English edition (with neither index nor bibliography) appeared in 1948, and since then an enlarged Chinese one has become available (1955).

^f Here we need do no more than refer to Chinese histories of chemistry in general—Chang Tzu-Kao (1); Ting Hsü-Hsien (1). These paid little or no attention to the early indigenous developments.

Bernard Read and a Korean chemist Pak Kyebyŏng produced their still valuable précis-translation of the entries for most of the inorganic substances in the *Pên Tshao Kang Mu* (+1596). Much activity went on at the West China Union University at Chhêngtu in Szechuan, where Roy Spooner collaborated with C. H. Wang, making a historical chart of Chinese alchemy,^a H. B. Collier collaborated with Fêng Chia-Lo, collecting alchemical books,^b and Kuo Pên-Tao pursued his parallel and deep researches into Taoism. But by far the widest influence was exerted by the book of Obed Johnson, finished by 1925 and printed in Shanghai three years later. This *Study of Chinese Alchemy* was based chiefly on what could be got from the Confucian and Taoist classics, and from books such as the *Chuang Tzu* and the *Huai Nan Tzu*, but it also made some use of the dynastic histories, showing clearly that while the elixir concept had been mightily prevalent during the Chhin and Han it did not manifest itself in European alchemy until the time of Roger Bacon and the incorporation of Arabic knowledge. Although Johnson knew the work of Wieger he curiously made no attempt to use the alchemical works in the *Tao Tsang*.

After Johnson things were never quite the same. His work directly stimulated Arthur Waley in England to make several contributions (10, 14, 24) which raised the subject to a previously unattained level of scholarship. It also obliged the great synthesisers to take China seriously. Abel Rey, to be sure, had little to offer, but he was the prisoner of his own design, for *La Science Orientale avant les Grecs* embodied the erroneous and embarrassing assumption that there was no science there after them. George Sarton, on the other hand, did his best to give credit to the Chinese names that he knew of in his encyclopaedic history of science (1927-47) down to the +15th century, and realised that there was far more to come as research proceeded.

With the work of Tenney Davis and his collaborators (1930-43) again a new era opened.^c Davis was an eminent explosives chemist who acquired a number of Chinese and Japanese collaborators—Chao Yün-Tshung, Wu Lu-Chhiang (d. 1936),^d Chhen Kuo-Fu and Nakaseko Rokuro—and together they ploughed through a large number of Chinese texts, some from the *Tao Tsang*, dating from the +4th to the +14th centuries, producing literal translations of a none too sophisticated quality. Struggling pioneer work and arduous, it did much to broaden the range of Chinese alchemical texts which Westerners could get a glimpse of, and it was soon followed up by the *Pao Phu Tzu* translations of the Jesuit Eugen Feifel, better sinologically perhaps but lacking the chemical insight which Davis was able to give. Unfortunately in all their work his group could never overcome one fundamental handicap, their failure to realise that Chinese 'alchemy' consists of two parts, practical laboratory alchemy (whether aurifactive or iatro-chemical), i.e. *wai tan*,¹ and physiological alchemy,

^a We have a copy of one of the versions of this.

^b These ultimately came to rest (though that is not quite the right idiom) in our East Asian History of Science Library at Cambridge, and we should like to take this opportunity of thanking Prof. H. B. Collier for his kindness.

^c A bio-bibliography has been given us by Leicester & Klickstein (1).

^d Biography by Tenney Davis.

¹ 外丹

i.e. *nei tan*,¹ a quasi-Yogistic system in which the elixir was to be synthesised within the body of the alchemist himself. Since a very similar technical terminology was used for both, it is always necessary to take the hint, often by nuances more subtle than the Davis group could appreciate, which reveals which system is actually being talked about. We shall see more of this later. Nevertheless, the translations of Tenney Davis' group are not to be under-valued or ignored, for no sinologist, however learned, can substitute for the man who has spent years working at the laboratory bench.^a Furthermore, one of the collaborators, Chhen Kuo-Fu, went on to those deep studies of the *Tao Tsang* (1949-63) which made him a past master of the *nei* as well as the *wai*.

In 1934 A. J. Hopkins published his interesting, if rather confused, book on Hellenistic proto-chemistry or 'alchemy', in which he defended the old thesis that it arose from the application of Greek philosophy to Egyptian artisanal techniques. This led to a mild controversy with Tenney Davis, who by this time was convinced that all alchemy (in the strict sense, cf. p. 12 below) had originated in China and reached the Latins through the Arabs much later. Hopkins (2) and Davis (2, 3, 7, 13) are particularly interesting to read in the light of the theoretical considerations which we discuss in what follows (pp. 8 ff.).

This brings us to the last twenty years, which indeed have seen many advances. The two papers of the Oxford sinologist H. H. Dubs (5, 34) were a real attempt to think the problems out in the light of extended and well-based factual information, and if on many points we cannot follow him today it is because of faults of reasoning and speculation rather than of scholarship. Those who undertook general books on the history of alchemy and chemistry in the fifties and sixties now gave respected place to the Chinese contributions, e.g. Sherwood Taylor (3), Holmyard (1) and Leicester (1), while something also became available for Russian readers in the work of Figurovsky (1). Most important were the productions of Chinese scholars, two books especially, that of Yuan Han-Chhing (1), my friend at the Lanchow Science Institute in former days, and another by the veteran professor of Yenching University, Chang Tzu-Kao (2), which has been termed 'the first history of the subject which attempts to meet professional standards'. Valuable works in Japanese have also been given us, notably the general history of alchemy and chemistry by Yoshida Mitsukuni (5, 6), so clearly bringing out the prominence of aurifaction in early European proto-chemistry, and its contrast with the elixir motif in China, where chemistry was fundamentally medical from the very beginning. Then towards the end of the sixties there were the excellent studies of Asahina Yasuhiko (1) and Masutomi Kazunosuke (1) reporting analyses and identifications of the 8th-century chemicals preserved in the royal treasury of the Shōsōin at Nara.^b The secondary literature in Chinese also continued unabated, as one may see from papers such as those of Wang Chin (11) and Fêng

^a They formed the *pièce de resistance* for the influential compilation of W. J. Wilson (2a-e), in a Ciba Symposium of 1940.

^b Among earlier work on this same subject one may mention that of Dohi Keizō

¹ 內丹

Chia-Shêng (5), while other Chinese chemists wrote useful memoirs in English, e.g. Huang Tzu-Chhing (1, 2), Huang Tzu-Chhing & Chao Yün-Tshung (1).

Since Waley's time, forty years ago now, it has been evident that the full equipment of sinological apparatus must be brought to bear upon the alchemical and early chemical literature of China if substantial progress is to be made in elucidating its contribution to the world history of chemistry as a whole. Our own earlier papers, with Lu Gwei-Djen, Ho Ping-Yü and Tshao Thien-Chhin (from 1939 onwards, especially around 1959), were all conceived under the sign of this ideal. Equally it has animated the two great Western offerings of the sixties, Ware's integral translation (5) of the *Pao Phu Tzu* book (c. +320), and Sivin's richly annotated study (1) of Sun Ssu-Mo's *Tan Ching Yao Chüeh* (c. +640) with its translation of a critically established text. The first of these, though questionable in certain details, bears comparison with the giant efforts of the older sinology, reminding us of Forke's translation of the *Lun Hêng*, now nearly a century old yet recently re-issued. Many a young sinologist can now produce a better paragraph of Wang Chhung than Forke could, and doctorates can be won by the closer examination and emendation of particular chapters—fifty years hence Ware (5) will be in the same position, but in the meantime the service of such works to the meeting of East and West over the decades is incalculably great. Sivin's book is particularly valuable because of its supporting material, an analysis of the strategy of the subject, a detailed *lieh chuan* and *nien piao* of the great physician and alchemist himself, and abundant glossaries of elixir names, technical terms, chemical substances, diseases and the like.

Historians of chemistry are now fully prepared to welcome China into the ring of those civilisations which nurtured from its oldest beginnings the study of those properties of matter which we call by this name. They are prepared indeed to envisage a pattern in which Chinese culture will take an honoured place as the creator and originator of certain quintessential aspects of it. In his interesting survey of the whole field a few years ago, Debus (4) wrote: 'Not only did Chinese alchemy antedate that of the West, it had as a fundamental part of its quest the search for the health-giving elixir of life—a concept which appeared first in Western texts only in the +12th century by way of translations from the Arabic.' But Ganzenmüller (4) underlined a justified warning; he too suspected that Chinese alchemy was older than any other, but he demanded a strict date analysis of all the texts—only in this way could the civilisations be compared and titrated. We entertain the hope that this most justifiable request may be to some extent satisfied by the present volume.

(b) CONCEPTS, TERMINOLOGY AND DEFINITIONS

We now approach the most important cross-roads of the subject, or rather a forking of five or six 'went ways', where the wrong choice leads us into morasses and impenetrable thickets but the right one gains a view of how everything hangs together. Though so many thousands of pages have been written by students of alchemy and early chemistry within the European and Arabic culture-areas, even greater compli-

cations follow when any confrontation with the Chinese and Indian parallels is attempted, as it must be here; and our experience is that the necessary clarification demands the introduction of a few technical terms not hitherto generally current. Moreover we have to define in just what sense the word 'alchemy' is used in our discussions. Chemistry as we know it today is of course a science like that branch of physics which deals with electricity—wholly post-Renaissance, indeed + 18th-century in character; but the pre-history of chemistry goes back far into antiquity and the Middle Ages, and alchemy was the framework into which the men of those times fitted their chemical observations. This complex of ideas needs closer analysis than it has yet had.

The profound influence of Taoism on Chinese science, proto-science and medicine has been emphasised throughout our volumes. At an earlier stage^a we had occasion to speak about the primitive shamans of Chinese society, the *wu*,¹ and there can be no doubt that Taoist philosophy and religion took its origin from a kind of alliance between these ancient magicians and those Chinese philosophers who, in ancient times, believed that the study of Nature was more important for man than the administration of human society, upon which the Confucians so much prided themselves, and that his moral perfection depended much more on his integration with the natural cosmos than on his social relations with other men. At the heart of ancient Taoism there was an artisanal element, for both the wizards and the philosophers, the diviners and the cosmological thinkers, were convinced that important and useful results could be achieved by using one's hands. They did not share the mentality of the proto-feudal lords or Confucian scholar-administrators who sat on high in their tribunals issuing orders and never employing their hands except in reading and writing. This is why it came about that wherever in ancient China one finds the sprouts of any of the natural sciences the Taoists were sure to be involved, and chemistry was no exception. The *fang shih*,² technicians, thaumaturgical craftsmen, adepts, or 'gentlemen possessing magical recipes' (as Dubs used to like to call them),^b of whom we hear so much between the -5th and +5th centuries, were certainly in general Taoist, and they worked in all kinds of fields (apart from divination and incantation) as star-clerks and weather-forecasters, men of farm-lore and wort-cunning, leeches, irrigators and bridge-builders, architects and decorators, metal-winners and smiths, above all, alchemists. Indeed the beginning of alchemy everywhere rests with these magi if we take the word to mean, as surely we should, the combination of 'macrobiotics' and 'aurifaction'.

These terms are 'words of art', unusual but carefully chosen. With their help, and that of one more, we shall now state a case, the outline of a general theory as it were, applicable in our view to all the cultures of the Old World, not to Europe alone, and then proceed to give supporting evidence for the several parts of it, developing them

^a Sect. 10 in Vol. 2.

^b On this quaint translation see Yü Ying-Shih (2), p. 105; Sivin (1), p. 23.

¹ 巫

² 方士

in various directions in the remainder of this sub-section. Among the ancient Alexandrian proto-chemists in the West, let us say between the +1st and the +5th centuries, there were two groups with quite distinguishable endeavours, aurifaction and 'aurifiction'; and this is a pattern which can be identified in every civilisation.

Aurifiction we define as the conscious imitation of gold (and by extension, with suitable variation of nomenclature, silver and other precious substances such as gems and pearls), often with specific intent to deceive—whether by 'diluting' gold and silver with other metals, or by making gold-like or silver-like alloys with copper, tin, zinc, nickel, etc., or by the surface-enrichment of such mixtures containing gold, or by amalgamation gilding, or by the deposition of surface-films of appropriate tints produced by exposure of the metal to the vapours of sulphur, mercury and arsenic, or volatile compounds containing these elements. The deception of the client, or the aim of deception, is not essential in this definition, for he may be quite content with substances of a gold-like appearance,^a imitations which may serve his purpose,^b but the proto-chemical artisan must be aware that his product would not stand up to the fundamental test of cupellation. He must therefore know it to be, in the workshop sense, 'false'; though the very same processes may be employed by the philosophical proto-chemist to give a result which was considered, in the philosophical sense, 'genuine'.^c This paradox will become more understandable in what follows.

Aurifaction, on the other hand, we define as the belief that it is possible to make gold (or 'a' gold, or an artificial 'gold') indistinguishable from, and as good as (if not better than), natural gold, from other quite different substances, notably the ignoble metals. This was the conviction of philosophers rather than artisans, as we shall see. The self-deception of the proto-chemical philosopher is essential in this definition, not because of any credulity or unworthiness on his part but because in an age before the visualisation of the persistence of the atoms of the separate metals in the alloy, certain properties or qualities of the artificial 'gold' were precisely what justified its name. It was not thought necessary that all the properties of the yellow metal should be identical with those of natural gold so long as at least one of them was—heaviness, softness, ductility, malleability, internal uniformity, but colour was always by far the most important. As the poet said: 'the glitter is the gold'.^d We believe that the proto-chemical philosophers, both in East and West, often did not know of the test of cupellation (and for this we shall suggest a sociological reason), but even when they did they probably regarded it as irrelevant to their nomenclature, taking 'gold' to

^a As in the case of Wang Chieh and his emperor in the Sung period; cf. Vol. 5, pt. 3.

^b Here one might refer to the interesting argument of Ruska (11), pp. 313, 316, against Lagercrantz (2). Lagercrantz had assumed that 'alchemy' was always and everywhere deception, and had quoted passing, among other things, al-Kindi's letter to the Caliph (c. +830) on the chemistry of foods, *Kimiya al-Tabikh* (tr. Wiedemann, 28). This described imitations (presumably vegetarian) of meat, eggs, etc., analogous to the soya-bean confections for which Buddhist abbey cooks in China have long been so famous (cf. Sect. 40). Ruska, rebutting the idea that alchemy was invariably and necessarily fraud, pointed out that one must always leave room for *Ersatz* productions—imitation pearls and jade in ancient China, glass gems in Hellenistic Egypt, synthetic rubber and textile fibres today. Everything depends on the circumstances and the people concerned.

^c As among the Graeco-Egyptian practitioners of Hellenistic times (below, p. 20).

^d Cf. p. 71 below.

mean whatever had the form, accidents or qualities, more or less, of gold.^a This complex of ideas is of course that which has so often been thought in the past to comprise the whole of 'alchemy', but we find it extremely helpful in clarification to distinguish an aurifactive element from a macrobiotic element.

Macrobiotics is a convenient term^b for the belief that it is possible to prepare, with the aid of botanical, zoological, mineralogical and above all chemical, knowledge, drugs or elixirs (*tan*¹) which will prolong human life beyond old age (*shou lao*²), rejuvenating the body and its spiritual parts so that the adept (*chen jen*³)^c can endure through centuries of longevity (*chhang shêng*⁴), finally attaining the status of eternal life^d and arising with etherealised body as a true Immortal (*shêng hsien*⁵).^e Such was the Taoist concept of material immortality; we shall look more closely at it later on. But there was another predisposing cause for alchemical ideas in China, the absence of any prejudice against the use of mineral drugs analogous to that which existed so long under the Galenical domination in Europe; indeed the Chinese went to the other extreme, compounding with remarkable persistence through the centuries all kinds of dangerous elixirs containing metallic and other elements (mercury, arsenic, lead, etc., as well as gold) which caused untold harm to those who resolutely took them.^f However the Taoist, if he chose, could avoid these dangers, for there were many other techniques available in the quest for material immortality, not only alchemical and pharmaceutical but also dietetic, respiratory, gymnastic, sexual, heliotherapeutic and meditational. With all these could he aspire to incorporation into the ranks of the invisible bureaucracy of the universe as a Heavenly Immortal (*thien hsien*⁶); or else seek for transformation into a *ti hsien*,⁷ an Earthly Immortal, purified, ethereal and free, able to spend the rest of eternity wandering as a kind of wraith through the mountains and forests, enjoying the company of similar enlightened spirits and the

^a In scholastic philosophy an accident was a property or quality not essential to our conception of a particular being or thing (as whiteness to paper or sweetness to food). In the 'transubstantiation' theory of medieval Latin theology, the accidents of the consecrated elements (bread and wine) in the eucharist remained the same, but the substance fundamentally changed. In alchemical transmutation, the substance (*materia prima*) remained the same, but its accidents changed, leaden colour, for instance, being exalted to golden.

^b It was used in this way by Forke (4), vol. 1, pp. 63, 83, etc., and occasionally by other German sinologists. It recalls of course the immortal Hippocratic aphorism which we quoted in the preface of Vol. 4 (pt. 1, p. xxxi, pt. 2, p. li, pt. 3, p. liii). Recently it has been revived as the name of a dietary cult in London and New York; with that we are not concerned here. But the fact that this cult seems to have originated in Japan may not be without interest. Cf. Sakurazawa (1).

Alternatively, there is the ingenious coinage 'prolongevity', a word formed by Gruman (1); but it would not quite meet our need, since its nuance falls short of that infinity of earthly or celestial (though not transcendental) existence which the Taoists were prepared to contemplate.

^c Properly speaking, this title, 'Perfected' or 'Realised' Man, belonged to the high ranks of the supernal bureaucracy of immortals (cf. pp. 109 ff. below), but it was early applied in a complimentary sense to adepts in the mundane world. Cf. Chhen Kuo-Fu (1), p. 279.

^d It should not be thought that centuries of longevity were an invariable prelude to this, for in some cases promotion to the ranks of the immortals could come quickly and suddenly.

^e To the elixir we should add the 'enchymoma', i.e. a macrobiotic medicine prepared not from external substances but from the juices and *pneumata* within the body of the adept himself (see Vol. 5, pt. 5).

^f See Sect. 45 below, and meanwhile Ho Ping-Yü & Needham (4).

¹ 丹

² 壽老

³ 真人

⁴ 長生

⁵ 昇仙

⁶ 天仙

⁷ 地仙

cycle of the seasons ever repeated yet with glory ever renewed. These are the beings that one can discern, tiny against the immensity of the landscape, flitting across remote ravines in many beautiful Chinese paintings.

The three key operational conceptions which we have now described, gold-faking, gold-making, and the preparation of the drug of deathlessness, are, we believe, applicable to all the aspects of early chemistry in every civilisation, and can be relied upon to bring them into inter-relation. In the light of these definitions it is clearly essential that alchemy should be distinguished both from aurifiction and aurifaction alone; if so, the Hellenistic proto-chemists ought not to be called 'alchemists', for there was little or no macrobiotics in their thinking.^a The word 'elixir',^b in the opinion of many, serves best to define 'alchemy' itself,^c for the macrobiotic pre-occupation came into Europe only with the transmission of Arabic chemical knowledge from the +12th century onwards,^d and since alchemy is after all a word endowed with the Arabic prefix it is appropriate enough not to speak of it in Europe until that age had dawned. It then took some time to exert its full effect, but the emphasis on a longevity which chemistry could produce reached full force in the writings of Roger Bacon (+1214 to +1292). There was plenty of aurifiction, aurifaction and proto-chemistry in general in the West before that time, but not the attempted preparation of longevity-promoting substances, or what we may conveniently call 'macrobiogens'. On the other hand Chinese proto-chemistry (*lien tan shu*)^e was real alchemy from the very beginning, and precisely because of the conception of material immortality dominant there and only there.^f It was no coincidence that the sentence on longevity written at the beginning of the previous paragraph was illustrated by Chinese technical terms, for that was the civilisation where they really meant something, and although there were certain counterparts in the Hellenistic world such as the *pharmakon tēs athanasias* (φάρμακον τῆς ἀθανασίας), they turn out on closer inspection to be much more metaphorical.^g

The two ideas of macrobiotics and aurifaction came together first in the minds of the Chinese alchemists from the time of Tsou Yen in the -4th century onwards, for the first time, it seems, in any civilisation.^g As we shall see, there was aurifiction in China too, sufficiently widespread to evoke an imperial edict in -144 forbidding

^a This does not mean that Hellenistic proto-chemistry was not saturated with Gnostic and Hermetic mysticism; that it certainly was, but this mystical aurifaction led to the allegorical-psychological forms of later Western alchemy, not to the elixir concept itself and to iatro-chemistry.

^b There is of course a Byzantine Greek derivation of this term, but a Chinese origin for it seems now at least as possible; see on, Vol. 5, pt. 4.

^c On the vexed question of the origin of the root 'chem-' see the discussion in pt. 4 below.

^d There is very little sign of it before that time, *pace* Thorndike (1), vol. 1, pp. 697ff., 772ff.

^e In some of his formulations (3, 4) Tenney Davis came very close to the viewpoint expressed in this paragraph, confused though the discussions of the thirties were by many misunderstandings and irrelevancies. It was quite clearly stated, however, by Mahdihassan (31), p. 25, (33), p. 80; cf. also Haschmi (6).

^f We discuss this more fully on pp. 72ff. below.

^g For the evidence concerning Tsou Yen and the School of Naturalists, see Vol. 5, pt. 3 below. The connection between immortality of some kind or other and the metal gold as such is a good deal older, and seems primarily Indian. See pp. 118ff. below.

¹ 煉丹術

unauthorised private minting and the making of 'false yellow gold';^a and if these metallurgical proto-chemists had no other interests they were certainly not alchemists in our sense. But only a few decades after those activities, by -133, when Li Shao-Chün¹ was urging the emperor to support his researches,^b and -125, when Liu An's² group of natural philosophers was compiling the *Huai Nan Tzu*³ book,^c the connection between aurifaction and longevity-immortality (probably originating from Tsou Yen's⁴ earlier school) is clearly recognisable. Thus began that association between the manufacture of the imperishable metal, gold, and the attainment by man of earthly imperishability, which was to spread in later centuries throughout the whole world.^d At first it took the form that plate and vessels of artificial gold possessed a magical property of conferring longevity or immortality upon whoever should eat and drink from them, functioning doubtless as containers for the elixir substances of vegetable origin, the 'herbs of deathlessness' (*pu ssu chih tshao*⁵) which the proto-feudal princes of the Warring States, and then the First Emperor, Chhin Shih Huang Ti himself, had been so eagerly looking for since the middle of the -1st millennium.^e The aurifactive 'art of the yellow and the white' (*huang pai chih shu*⁶), initiated, it seems, by Tsou Yen⁴ and his companions, comes clearly into focus with Li Shao-Chün¹ and Liu An,² as also Liu Hsiang⁷ (c. -60)^f and Mao Ying⁸ (c. -40).^g What is more, the process of 'projection', whereby a small amount of a potent chemical or powder (the familiar 'philosophers' stone' of the medieval centuries) is added to some substrate converting it all into precious metal, appears in China at least by the end of the -1st century; though we cannot be sure whether to place the story^h of Chhêng Wei⁹ about +15 or in the neighbourhood of -95. Meanwhile the idea that artificial or natural gold should not be confined to rustless vessels but should actually be ingested, taken into the human body in some form or other, was also growing up. One of the oldest

^a The details will be found in Vol. 5, pt. 3 below.

^b See Sect. 33 (e), where the essential passage is translated, and meanwhile Needham (70).

^c On Liu An's connection with alchemy cf. pp. 97, 124, and Vol. 5, pt. 3 below.

^d There were certain particular reasons, not operative in any other civilisation, why metallic gold should have assumed this dominating position in China. To be sure, everywhere in the world men considered gold the most beautiful of the metals, and everywhere also its incorruptibility was recognised. But in Chinese culture yellow was the colour of the centre among the five regions of space, corresponding to the Earth element and all that went with that in the symbolic correlations system (cf. Vol. 2, pp. 262-3); accordingly it was (for most of Chinese history) the colour signifying imperial might, mana and dignity. Still more, it was the colour of the world beyond, for the place of the dead, somewhere underground, was called the 'Yellow Springs' at least as early as the -8th century (cf. pp. 81, 84-5 below). These associations, noted already by Eliade (5), p. 118, need pointing out because of their relevance to the conviction which will develop as we go along that China was the only culture in the ancient world where the full doctrine of elixir alchemy could have arisen.

^e Possible connections with the Indian-Iranian *soma-haoma* are discussed on p. 115 below. There is a special study on the plants the Taoists used, by Roi & Wu Yün-Jui (1).

^f See p. 48 and Vol. 5, pt. 3.

^g See pp. 234-5 and Vol. 5, pt. 3.

^h Given in Vol. 5, pt. 3 below. As we shall see in another place (Vol. 5, pt. 4) the idea of projection, contrary to a frequently expressed opinion, is undoubtedly present in the writings of the Hellenistic proto-chemical aurifactors, but not earlier than the +1st or +2nd centuries. The conceivability of mutual exchanges at that early time is also considered there.

¹ 李少君

² 劉安

³ 淮南子

⁴ 騶衍

⁵ 不死之草

⁶ 黃白之術

⁷ 劉向

⁸ 茅盈

⁹ 程偉

references to the consumption of gold occurs in the text of the *Yen Thieh Lun*,¹ c. -80,^a and by the +1st century Fêng Chün-Ta² was taking mercury while Wang Hsing³ had some undescribed preparation of 'potable gold' (*chin i chih tan*).^b Older adepts had tried consuming powdered cinnabar, with other mineral and metallic substances; a practice for which we have much better evidence than the Taoist hagiographic texts, for an official report of the physician Shunyü I⁵ tells how in -160 he attended another medical man who had made himself ill by taking excessive amounts of mineral drugs.^c

In sum, the ancient Chinese alchemical tradition can be shown to have arisen from three distinct roots, (a) the pharmaceutical-botanical search for macrobiotic plants, (b) the metallurgical-chemical discoveries of processes for aurification and aurifaction, and (c) the pharmaceutical-mineralogical use of inorganic substances in therapy. All three must have started at least as early as the Warring States period, well before the Chhin and Han, and the unified tradition must have taken its permanent form by the end of the +1st century if not by its beginning.^d Systematised by Ko Hung⁶ early in the +4th,^e and extended by men such as Thao Hung-Ching⁷ in the +5th^f and Sun Ssu-Mo⁸ in the +7th,^g it necessarily forms a large part of the substance of this Section. It constituted the world's oldest chemo-therapy.

The thought linkage thus established between aurifaction and immortality was destined to have nearly twenty centuries of life, taking on in due course the formulation that all the other metals, rusting and corroding, suffered from the same illness as mortal man, so that the philosophers' stone would be the supreme medicine of men as well as of metals. Both of them it would cause to put on incorruptibility, its essential tendency being to transmute 'imperfect' things into 'perfect' ones.^h 'Alchemy', we read in the +13th-century *Speculum Alkimie Minus* attributed to Roger Bacon, 'is the science which teaches how to make and generate a certain medicine, called elixir, which when projected on to metals or imperfect bodies perfects them completely at the moment of projection.'ⁱ And also, in words genuinely his own, written about +1266: 'That medicine which will remove all impurities and corruptibilities from the

^a The passage is translated in Vol. 5, pt. 3.

^b See also pt. 3. Although for some of these cases the evidence is of later date, the general flow of events, discernible on other grounds, makes it acceptable enough. In considering references such as this, however, one should always bear in mind (a) the possible *nei tan* (physiological alchemy) interpretation, on which see Vol. 5, pt. 5; and (b) the fact that in subsequent times at any rate the pharmacutists were capable now and then of giving names of this kind to mixtures of plant drugs. But that was of course derivative from a prior aurifactive alchemy, and probably neither proviso is applicable here.

^c Cf. Vol. 5, pt. 3 where the text is given.

^d This genetic picture is further developed in pt. 3 below.

^e See the sub-section devoted to him in pt. 3.

^f See pt. 3 below.

^g See pt. 3 below.

^h Hence the definition proposed by Sheppard (6): 'alchemy is the art of conversion of that which is base, both in the material and spiritual worlds'. For us this is too wide and vague; it could admit aurifaction without macrobiotics.

ⁱ Tr. Davis (8), p. 1946; cf. Hopkins (1), p. 214. In some manuscripts the authorship is attributed to an otherwise unknown monk Simeon of Cologne, but the real writer remains uncertain; see Birkenmaier (1) and Sudhoff (1). Cf. Multhauf (5), p. 196; Read (1), p. 24.

¹ 鑪鐵論

² 封君達

³ 王興

⁴ 金液之丹

⁵ 淳于意

⁶ 葛洪

⁷ 陶弘景

⁸ 孫思邈

lesser metals will also, in the opinion of the wise, take off so much of the corruptibility of the body that human life may be prolonged for many centuries.^a We quote from Roger Bacon, one of the first Europeans to discuss alchemy in the full sense, not only aurification or aurifaction; but similar ideas could, we believe, be illustrated from the literature of all those cultures, Indian, Iranian and Arabic, through which flowed the current of this great creative dream that brought chemistry to birth throughout the Old World. That Arabic alchemy had a far more medical stamp than Hellenistic proto-chemistry, primarily metallurgical, has been well noted by an acute observer,^b but this is even truer of Chinese alchemy, where Taoism, medicine and alchemy were always intimately connected, not only theoretically but in practising individuals time after time. There can now be no doubt that the Arabic experimentalists and writers were deeply influenced by Chinese ideas and discoveries,^c perhaps indeed hardly less than by the Hellenistic aurifactive proto-chemistry which Byzantine culture had preserved. One could even go so far as to say that what had happened in East Asia was largely responsible for setting the definitive alchemical style which lasted in European culture from about +1150 till the age of Paracelsus,^d Libavius, Boyle, Priestley and Lavoisier (+1500 to 1800), giving rise in all three civilisations to a wealth of discoveries in chemistry and chemical technique.

(1) AURIFICATION AND AURIFACTION IN THE WEST

So much for the outline of the scheme of interpretation on which all our estimates are based. It is now necessary to develop the theme in various ways. First then we must contrast the technique of aurification with the philosophy of aurifaction, and it will be best to begin with what for Westerners is nearest home, namely the proto-chemistry of the Hellenistic world centred on Graeco-Egyptian Alexandria. Later on, in the body of this Section, there will be plenty of occasions for seeing how the two concepts manifested themselves through the centuries in China.

Just now we alluded to the existence of two quite distinguishable groups in Hellenistic Egypt, the technical artisans of aurification and the mystical philosophers of aurifaction. This division corresponds more or less with the two main types of literature which have come down to us, on the one hand a group of chemical papyri of the +3rd century, written in Greek, on the other a Corpus of 'alchemical' writings, also in Greek, starting about the +1st century, first collected probably in the late +7th or early +8th century,^e but not available to us in any manuscript older than one which was written within about half a century each way of +1000.^f Since these are so

^a *Opus Majus*, Jebb ed. p. 472; Burke tr., vol. 2, p. 627; Germ. tr. Ganzelmüller (2), p. 181. On Roger Bacon's work and ideas as a whole see Thorndike (1), vol. 2, pp. 616 ff. On his macrobiotics see Vol. 5, pt. 4 below.

^b Temkin (3).

^c See also pt. 4.

^d The task of alchemy is not to make gold, but medicines, he says, in *Paragranum*, III, Sudhoff ed., vol. 8, p. 185; Strebel ed., vol. 5, p. 114; cf. Walden (4); Ganzelmüller (5).

^e Cf. Festugière (1), p. 240.

^f This is the Venetian Marcianus 299, our basic source. Paris Gr. 2325 is of the +13th century, and Paris Gr. 2327, 2275 and 2419 all of the +15th, but sometimes these are more complete than the oldest MS. Cf. Berthelot (2), pp. 173 ff., 200 ff.

As we have had occasion to observe elsewhere (Vol. 3, p. 622), texts for which there is no independent

well known, description can be very brief. Early in the nineteenth century, Jan d'Anastasy, Swedish Vice-Consul at Alexandria, acquired a large collection of papyrus which ultimately found their way to museums in Holland and Sweden. Not until 1885 however, when Leemans (1) published Pap. Leiden X, was it realised that a cardinal document in the history of chemistry had been preserved,^a and then when in 1913 Lagercrantz (1) published Pap. Holmiensis from Stockholm^b half as much again of material on the processes of the Alexandrian chemical technicians came to light.^c The former document seems to have come from Thebes, the latter from Alexandria. The Leiden papyrus is almost wholly concerned with the working of metals, especially the precious ones, but while the Stockholm papyrus has a certain amount of material on this subject, it is mainly devoted to processes for mordanting and dyeing textiles and for preparing artificial gems. Neither has any references of a theoretical nature to Greek or other philosophy. Leiden X mentions no authority except once Phimenas, seemingly an Egyptian; Holmiensis mentions a Democritus, an Anaxilaus and an Africanus who had written a book in at least three parts.^d

Now for the Corpus.^e We shall have to look at it in closer detail in the sub-section on parallelisms and transmissions (Vol. 5, pt. 4); here only a word on its principal authors, or ostensible authors, need be said. Their dating has been a matter of considerable controversy; this centres round the fragmentary work *Physika kai Mystika* (φυσικά καὶ μυστικά)^f written apparently by one Democritus, much later than his namesake

evidence for eight centuries or so after their presumed date tend to be viewed with much suspicion in sinological studies, but for various reasons such as the use of parchment, the late date of printing and the like, such strict canons seem not to apply in European classical and humanistic fields. Besides in this case the internal evidence is such as to connect closely the Corpus with the papyri (cf. Berthelot (1), pp. 68, 80).

^a The text with a French translation was published by Berthelot (12), besides which there are detailed descriptions in Berthelot (1, 2). An English translation with notes was done by Caley (1).

^b English translation and notes by Caley (2).

^c The Leiden papyrus has 111 entries or recipes, while the Stockholm one has 152 or on some counts 154. There is a valuable discussion of both by Hammer-Jensen (1).

^d This Democritus may or may not be the same as the Pseudo-Democritus in the next paragraph. Anaxilaus is almost certainly Anaxilaus of Larissa, a magician-technician who was expelled from Rome in -28, cf. Wellmann (2). Africanus is Sextus Julius Africanus (d. +232), a writer on all kinds of techniques, especially chemical (cf. Berthelot (1), p. 187). Leiden X also ends by quoting ten sections on norganic preparations from the materia medica of Dioscorides (+60).

^e Ed. Berthelot & Ruelle (1), cit. herein as *Corp. Alchem. Gr.*, though of course we do not accept the term 'alchemy' here. Nor did Charles Singer, though his reasons may have been rather different. 'There is a series of writings in Greek', he said (8), p. 9, 'which has become known as "Greek alchemy", a title both unfortunate and unsuitable. It is unfortunate because it has led to the misapprehension that alchemy has its roots in Greek civilisation. It is unsuitable because this literature does not embody the doctrines that are generally recognised as characteristic of alchemy...' Possibly he had in mind the elixir motif, as we do, but it is hard to say; in another, lexicographic, article (13), he was content with aurification as the main criterion. In any case, he felt sure that the Egyptian element was preponderant over the Greek in the mystical Hellenistic proto-chemists. This is still open for discussion. Greek historians of chemistry such as Stephanides (1) and Zacharias (1) also deny to Hellenistic *chymēutikē* the name of alchemy because they try to minimise to the utmost its aurifactive aspect and emphasise its purely chemical and metallurgical technology. As for the Corpus itself, apart from the usual up-to-date accounts such as Holmyard (1) and Leicester (1), there are the basic works of Berthelot (1, 2), and the penetrating studies of Sherwood Taylor (2, 3, 7).

^f *Corp. Alchem. Gr.* II, i.

the pre-Socratic atomist philosopher (d. -375), and hence called Pseudo-Democritus. As this work refers to no one else, except to a master Ostanes (perhaps significantly) the Persian,^a but is quoted by nearly all the others, it is generally regarded as the oldest; and it is certainly important as it describes the 'gold-making' (*chrysopoia*, χρυσopoία) and the 'silver-making' (*argyropoia*, ἀργυροποιία). For some time it was thought possible to identify Pseudo-Democritus with a Graeco-Egyptian naturalist, Bolus of Mendes the Democritean, who certainly flourished in the first quarter of the -2nd century and wrote much (on drugs, dyeing, prodigies, sympathies and antipathies, etc.), now all lost save the titles and a few fragments.^b The other extreme was to date Pseudo-Democritus as late as the last half of the +5th century, and all the other writings of the Corpus correspondingly later.^c Suffice it to say that when one considers all the evidence the best solution is to place Pseudo-Democritus in the +1st century or just possibly the last decades of the -1st, a man doubtless indebted to the writings of Bolus but also to important influences from further east (as 'his master Ostanes the Mede' suggests), a man deeply at home in the Gnostic and Hermetic schools^d but also acquainted with at least the popular versions of Peripatetic philosophy. This being done, the rest follows—Comarius and Pseudo-Cleopatra, together with the important inventor of laboratory apparatus Mary the Jewess, and a number of lesser figures,^e come in the +2nd, Zosimus of Panopolis the great systematiser and allegoriser,^f with Iamblichus, towards the end of the +3rd, and Synesius (probably not the same as the Bishop of Ptolemais) towards the end of the +4th. Then come the commentators, Olympiodorus towards the end of the +5th century and Philosophus Christianus in the late +6th, Stephanus of Alexandria early in the +7th^g and the Philosophus Anonymus later in the same. Last are the collectors of fragments, George Syncellus in the late +8th, Photius in the +9th and Suidas in the late +10th; which brings us, with the confused and poetical author Michael Psellus^h about +1045, to the date of writing of the oldest extant manuscript of the Corpus.ⁱ Such were the 'oecumenical philosophers', the group down to and including Stephanus, in the words of later writers.

^a Cf. Vol. 5, pt. 4 below.

^b This was the view of Diels (1); and Festugière (1), in the most exhaustive discussion of the subject, would like to have followed it, but set forth honestly the almost insuperable difficulties in doing so.

^c Except the book of Comarius and Cleopatra (*Corp. Alchem. Gr.* iv, xx), which Hammer-Jensen (2), who adopted this position, was willing to assign to the +4th century or early +5th.

^d See Festugière (1); Nock & Festugière (1); Scott (1); Sheppard (1). On the general background of magic and thaumaturgy see Hopfner (1), and for the astrology Gundel & Gundel (1). Perhaps the best short account of Hermetic philosophical theology is that of Festugière (2). He does not remark, however, on the similarities of its dualism with that of the important Manichaean religion a few centuries later.

^e E.g. Pebechius, Petasius, Petosiris, Pammenes, Panseris, Pelagius.

^f His visions also translated by Taylor (8); and more fully by Jung (14); Glover (1).

^g Not in *Corp. Alchem. Gr.* but available in Taylor (9).

^h On him see Bidez (1), with translation. On Byzantine chemists or alchemists later than him cf. Zuretti (2).

ⁱ There may yet be more fish in the sea than have come out of it, for Dr Włodzimierz Hubicki tells us that the Cassel Library preserves a Corpus of ancient proto-chemical or alchemical MSS, of which Berthelot never knew. It has the names of many authors different from those in the famous Marcianus and Paris codices. All conclusions must therefore be, as always, provisional.

The moment one compares the two types of text one sees that the papyri were the work of technicians who intended to deceive,^a while the writings of the Corpus were set down by chemical philosophers who believed that gold in some sense had really been produced in their operations. For example, in Leiden X we find the following statements:^b

- no. 8 'It will be *asem* (i.e. *electrum*, an alloy of gold and silver)^c which will deceive even the artisans.'^d
 (a tin-copper-gold-silver alloy)
 17 'Falsification of gold' (title).
 (a zinc-copper-lead-gold alloy)
 23 'For whitening copper, in order to mix it with equal parts of *asem*, so that no one can recognise it...'
 (a copper-arsenic-gold-silver alloy)
 38 'For giving to objects of copper the appearance of gold... It is difficult to detect the deception because rubbing (with the touchstone?) gives the mark of a gold object, and heat will consume the lead but not the gold.'
 (gilding with a lead-gold alloy in a gum)
 40 'The metal will be as good as pure *asem*, so much so as to deceive the workers themselves.'
 (a tin-copper-gold-silver alloy)
 57 'It can be submitted to the test for regular gold.'^e
 (gilding with mercury-gold amalgam).

Further points which may be noted at this stage are that the 'debasement' of the precious metals is always referred to as 'doubling' (*diplōsis*, διπλωσις), or 'tripling',^f and that some of these 'diluent' were high-tin bronzes analogous to those described in the 4th-century *Khao Kung Chi*.^g Most important is it that these Graeco-Egyptian metal-workers were well acquainted with the process of cupellation whereby gold and silver can be separated from all other metals—the purification of gold is described in no. 43, that of silver in nos. 26 and 44, and cupellation or cementation with salt, which gets rid of silver as the chloride, occurs in nos. 15, 20, 20a and 25. Thus they knew very well what they were doing, and they could test as we do (*dokimazein*, δοκιμάζειν)^h for the purity of the precious metals. The wide dissemination of artificial products in the early centuries of our era is well shown by a passage in

^a One must think of them as quite well educated, for the papyri mention Anaxilaus and Sextus Julius Africanus (cf. p. 16). No doubt they also read the works of Bolus of Mendes.

^b See Berthelot (2), pp. 30-8; Caley (1).

^c *Asemon* was a common word for bullion (gold, silver or mixed) in the Babylonian Talmud (+2nd cent.), cf. Sperber (1), p. 113.

^d Cf. Stockholm Papyrus, no. 3, a high-tin bronze: 'It will be silver of the first quality, except that the artisans may notice something (peculiar) about it, because it has been made in this way.'

^e Undoubtedly the touchstone, not cupellation. On the use and antiquity of the touchstone see Vol. 3, pp. 672 ff.; it was very old in the Mediterranean region.

^f In Latin *augmentatio*. This idea lasted down as long as alchemy itself; we find it just at the meeting-point of Arabic and Latin knowledge in the *De Aluminibus et Salibus*, a compilation by an 11th-century Spanish practitioner (Ruska (21), pp. 84 ff., cf. Multhaus (5), pp. 160 ff.).

^g Cf. Vol. 4, pt. 2, pp. 11 ff.

^h Cf. I Thess. 5. 21. Berthelot (2), p. 57.

Themistius of Byzantium, written in the +4th century only as a parable for how one should be sure to choose the right philosophy:^a

If someone brings to the market-place artificial gold or imitated purple, or false gems, are you not angry? Do you accept them? Don't you have the market superintendent arrest the merchant for punishment by stripes as a charlatan and trickster? Is it not for the same reason that you search out many means of assaying gold, and testing for true purple dye and precious stones; and that you have assayers in attendance at the market whom you can consult when you buy, so that you may get expert advice in the purchase of these valuable things?

Of course, imitations could doubtless be sold as such. But *caveat emptor* applied over a region far wider than the Mediterranean, for as we may remember, false gems (coloured glasses, of which there is much in the papyri)^b were one of the leading items exported from Roman Syria to places as far away as India and China.^c

In striking contrast with all this is the tone of the Corpus from Pseudo-Democritus onwards, where the writers speak over and over again about the *chrysopoia* (χρυσοποιία) and the *argyropoia* (ἀργυροποιία) without the slightest suggestion that the gold-like and silver-like products which they obtained were not fully worthy of being called gold and silver. In a word, if the artisans were consciously carrying on aurification, the philosophers had begun what we call aurifaction. That they were at the same time much more mystical and allegorical is also clear, and they give the impression of having been more interested in a wider range of chemical phenomena, for example the various effects of distillation, with the new apparatus attributed to Mary the Jewess and Pseudo-Cleopatra.^d These new inventions, stills and retorts of various kinds (*ambix*, ἀμβίξ, including the reflux condenser known as the *kērotakis*, κηροτακίς)^e have been considered, together with the exploration of the properties of the vapours of sulphur, arsenic, mercury and their compounds, the really great achievements of the Hellenistic proto-chemists.^f And most of what they did was under the sign of 'tingeing' or tinting, a conception undoubtedly derived from the dyeing of textiles,^g so that everything depended on the making of alloys, generally containing some precious metal, and the deposition of coloured films upon their surfaces.^h Just as the fibres of the cloth were coloured through and through by the mordant and the dye, so also gold-like and silver-like appearances, to say nothing of beautiful blue, green, grey and purple surface-films, could be produced by these ancient metallurgical philosophers, who may have ignored the fact that they did not always suffuse the whole mass. The language is so obscure, and the exact meanings of the technical terms for particular substances so uncertain, that it is now often quite difficult to make out

^a *Orat.* XXI, 247, tr. Hammer-Jensen (1), eng. auct.

^b Ruska (20) has discussed these techniques, in Arabic as well as Hellenistic sources. Further light may be obtained from the study of M. D. S. Lewis (1) on 'antique paste jewellery'.

^c Cf. Vol. 1, p. 199.

^d See Berthelot (2), pp. 127 ff. Besides distillation and sublimation, they knew of fusion, calcination, solution, filtration and crystallisation. Cf. Vol. 5, pt. 4.

^e Cf. pt. 4 below.

^f Hammer-Jensen (2), p. 41.

^g On this point the long and interesting paper of Pfister (1) is to be consulted. Cf. p. 28 below.

^h Hopkins (1), pp. 80, 83, (3), (4). Cf. pp. 251 ff. below.

exactly what was done,^a but the first three descriptions of the *chrysopoia* in Pseudo-Democritus have been interpreted as (i) the giving of a gold or silver colour to copper or bronze by the use of alloys of mercury or arsenic, (ii) the treatment of an argentiferous mineral with another metal to get an alloy which is then coloured yellow by an undescribed reagent, (iii) the roasting of silver-containing pyrites followed by treatment with salts, perhaps to get the chloride, then a heating with sulphur and alum, ending in an alloy of silver and gold with other metals.^b 'Thus you will obtain gold', 'in this way gold will be made', says the text time after time. The great question is (and it signifies for aurification in all civilisations), how could it be that the philosophers could believe that they were making 'gold', when the artisans were quite sure that they were successfully imitating it? How did technical aurification generate mystical aurification? How was it possible that the idea of the transmutation of base to noble metals could arise in a world which had known the refiner's fire and the test of cupellation for a thousand years already?

So far could this contiguity go that the philosophers and the artisans can be seen to have been using almost identical procedures. It is curious that Pseudo-Democritus and the Leiden papyrus X both refer with respect to Pammenes or Phimenas, a great artist in *chrysopoia*.^c The identification as one person has been strongly contested,^d but it is not important, for in any case both texts deal with such matters as the doubling or *augmentatio* of gold and silver by alloying them with *claudianum* (an alloy of copper, zinc, tin and lead, yellowed by sulphides or arsenic), or again the surface enrichment of gold-containing mixtures,^e the gilding with mercury from cinnabar, etc. Both groups of experimentalists were thus working with compositions which were essentially brasses, i.e. alloys of copper with up to 30% Zn and perhaps some impurities.^f The line between aurification and aurifaction therefore becomes very thin, yet it will still run with perfect clarity between those who defined gold as we do today,^g knew and practised cupellation, and carried on their operations with intent to deceive—and on the other hand those who found adequate philosophical and mystical justification for calling any gold-like substance that they made 'a' gold, as good indeed as natural gold if not better because made by art, and even if they knew of it, ignored the test of cupellation. Aurification or aurifaction would thus depend on what you thought you were doing, conscious fraud, knowing that there were artisans who, if put to it, could unmask you; or proto-chemical ingenuity fortified by a philosophical theory, no intention of making money directly out of it, and either no knowledge of, or no conviction of the decisive character of, the test of the refiner's

^a Cf. Partington (4), p. 22.

^b *Corp. Alchem. Gr.* II, i, 4 ff.; interpretations of Stillman (1), p. 157; Leicester (1), p. 45.

^c See Berthelot (2), pp. 24, 45, 66, 70 ff. Pap. Leiden X, no. 84, *Corp. Alchem. Gr.* II, i, 19.

^d As by Diels (1), p. 134; Hammer-Jensen (1), p. 283, (2), p. 88.

^e Stockholm Papyrus, no. 2, mentions a Democritus as well as Anaxilaus, in this specific context. One cannot say whether this refers to our Pseudo-Democritus, but it could do so.

^f Some modern ones instanced here by Berthelot (2), p. 66, have more Zn than this, so they could not have been made before the isolation of the metal (cf. pp. 206, 214).

^g Not exactly, of course, in the absence of an understanding of what is meant by a chemical element, but the acceptance of the sum of the physical properties, and especially the great resistance to oxidation on heating.

fire.^a The key to the problem is thus two-fold, on the positive side a justifying philosophy, on the negative side a total lack of understanding of the persistence of the element atoms side by side in the alloy.

(i) *The theory of chrysopoia*

That the positive justification was the Peripatetic philosophy of Plato and Aristotle, prime in importance therefore for the beginnings of aurifaction in Europe, was the burden of a book by Hopkins (1), well known in its time.^b J. R. Partington sometimes used to say that he thought Hopkins had been on the wrong track altogether, and that the only real theoretical core of the Hellenistic proto-chemical movement was the Orphic-Gnostic-Hermetic strain.^c I also at one time accepted this, but on further consideration it does seem that the beginnings of aurifaction cannot have come about in the absence of a metaphysical theory. The proto-chemists like Pseudo-Democritus, Comarius, Mary, Pammenes and Pseudo-Cleopatra were doubtless not professional philosophers, but Aristotelian natural philosophy was part of the general knowledge of well-read people in their world.^d At the same time we cannot under-rate the role of mystical pantheism among them; one might say that to begin with they were educated dilettanti who found in the operations of the metallurgical-chemical artisans something that could be used for the extremely important and different purpose of making models of the cosmic processes and cycles (as they understood them), in order to achieve a kind of salvation or release from the transience of uncomprehending mortal man.^e Soon of course the movement acquired an impetus of its own, especially after the invention of new forms of chemical apparatus. But where Peripatetic philosophy was essential was for the theory of its aurifaction.^f

Putting this in the crudest and simplest way, Aristotelianism recognised brute inchoate matter (*prōtē hylē*, *πρώτη ὕλη*) on one side, and organising form (*eidos*, *εἶδος*)

^a Hammer-Jensen (2), p. 73, well perceived the rift or gulf between the artisans and the philosophers. The latter, she thought, may have been influenced by the obtaining of gold from auriferous sands by amalgamation, which is clearly described in *Corp. Alchem. Gr.* III, xlv, 3. This could have seemed like the transmutation of base material into true gold, contrary to the processes of the debasing artisans. Cf. Pliny, *Nat. Hist.* xxxiii, xxxii, 99.

^b Unfortunately Hopkins' exposition was so muddled that this did not come out clearly. Nevertheless it is still worth reading, and though not quite adequately documented contains many original discoveries and useful insights. Of course he consistently spoke of alchemy where we should say aurifaction.

^c On this see Sheppard (1, 2, 4, 5), with many valuable references to the literature on the mystery religions and Gnosticism. There is still scope, however, for some enquiry into Manichaean influence, after the +3rd century.

^d The best place to study Aristotle's own ideas on chemical phenomena is in the fourth book of the *Meteorologica*, once thought due to a pupil but now regarded as authentic though not intended for that particular book. There is a new translation and study by Düring (1). But the *De Generatione et Corruptione* is also important. There are special papers on Aristotle's chemical concepts by Joachim (1) and von Lippmann (12).

^e On this see Festugière (1), pp. 260ff., 282. If immortality in the transcendental Western sense was involved in this, it was poles apart from Taoist this-worldly persistence.

^f Or, as Hopkins (1) put it, alchemy 'did not exist until philosophy was called in to explain the artistic creations of the workers in metals' (p. 7). Alchemy (i.e. aurifaction) as a marriage of Egyptian colouring craft and Greek philosophy was 'the first illustration of a scientific triumph, joining theory with practice' (pp. 50, 57). We seem to have heard of this kind of thing before (see Vol. 3, p. 159); perhaps it happens at all the great turning-points in the history of science.

on the other; but the many forms which matter could assume were not just obvious shapes, as of a statue or any solid object, they included also the physical and chemical qualities or properties of a piece of metal or mineral.^a Every substance^b was regarded as a unity and could have only one 'substantial form', the forms of the component substances (if such there were) being, so to say, sunk in it, and persisting only potentially. Thus when separate amounts of two metals, for example, were mixed, as in the case of copper and tin to make bronze, it was considered that the two substantial forms of the starting materials had disappeared, and that a third substantial form had come into existence, namely that of the bronze, which was now an entity in its own right, having a new physico-chemical 'form', whether or not it was moulded into the form of a vessel or a statue. Such a third body was called *meson* or *metaxia* (μέσον, μεταξία). It was not a mere mechanical mixture, or aggregate by juxtaposition (*synthesis*, σύνθεσις), but a true *krasis* (κρᾶσις) or *mixis* (μίξις), the component parts of which affected each other deeply.^c All this was perhaps one manifestation of the idea that the whole is more than the sum of its parts, in fact a piece of Aristotle's inveterately biological outlook, but however valuable this idea was in biology later on, here it might be described as 'premature organicism'.^d What it did for aurification was to justify the taking of an artificial gold, possessed of a certain yellow glitter and one or two other properties of natural gold, as 'a' gold, a sort of gold, i.e. a metallic preparation that had the substantial form of gold, even though demonstrably (if anyone was so tactless as to insist on demonstrating it) not identical in all respects with natural gold.^e

And by the same token, the Aristotelian theory of form and matter authorised the conception equally dominant in later European alchemy,^f that what the operator had to do was to strip the primal matter (*prima materia*, *terra virginea*) of its existing form, reducing it to the state of primitive chaos, and then to impose upon it other substantial

^a Leicester (1), p. 27.

^b Note the etymology, said Hopkins (2), that featureless stuff which 'stands underneath' the form and qualities which alone make it knowable to us. The locus classicus here is *Timaeus*, 50e.

^c As Joachim says, Aristotle recognised in principle the modern distinction between mechanical mixture and chemical combination, but in the absence of knowledge of the chemical elements, could not apply it correctly.

^d The doctrine of substantial forms is not all explicit in Aristotle's own texts, but was codified later, especially by Arabic thinkers such as Ibn Sīnā (Avicenna); cf. Multhauf (5), pp. 122, 149.

^e Leicester (1), pp. 7, 41. Gold was cited by Aristotle as an example of *mixis*. On the lack of ancient understanding of the nature of alloys, Berthelot (2), pp. 54ff., did well to point to the confusion of nomenclature between them and pure metals. The natural Au/Ag alloy had a single name, Eg. *asem*, Gr. Lat. *electrum*, while Lat. *aes* applied to bronze (Cu/Sn) as well as copper, and so did Ch. *thung*.¹ 'Corinthian bronze' (Au/Ag/Cu) was only a debased gold, and *claudianum* a debased copper (Cu/Pb). In Chinese, too, *chin*² meant any metal, though very often applied to the metal *par excellence*, gold, especially if preceded by the adjective yellow, *huang chin*.³ Cf. pp. 51ff. below. It seems that *thung*¹ was originally a word for bronze used by the people of the State of Chhu, judging from extant inscriptions, but it became universal during the Han (priv. comm. from Dr Chêng Tê-Khun).

^f In +1625 Marin Mersenne remarked that Aristotle was the ultimate and indispensable source of whatever was useful and acceptable in alchemical philosophy (*Verité des Sciences*, p. 167).

¹ 銅

² 金

³ 黄金

forms.^a Of course this was easier said than done, but the terminology is understandable, 'deprivation of the old substantial form' (*solutio, separatio, divisio, putrefactio*) being followed by 'addition of new substantial forms' (in *ablutio, baptisma*).^b The descent (*mortificatio, calcinatio*) to the lowest stage was described as *nigredo*, a blackening (*melanōsis, μελάνωσις*), but the ascent passed through a succession of colours, first *albedo*, a whitening (*leucōsis, λεύκωσις*), then *citrinitas*, a yellowing (*xanthōsis, ξάνθωσις*) and finally *rubedo*, a purpling (*iōsis, ῥωσις*).^c There are plenty of processes from which these terms could have originated, e.g. in order, the amalgamation process for gold-winning, the silvering of copper or lead by alloying or surface-deposition, the similar gilding of silver or copper by alloying or surface-deposition, and perhaps finally the production of iridescent mauve and purple finishes on bronzes by treatment with sulphides and acetates.^d

The idea of one primal matter and many forms was expressed very clearly in connection with aurification in a passage of Aeneas of Gaza written in +484, the oldest indeed in which there is mention of the art except in the texts of the Corpus itself.^e He makes his character Euxitheos say:^f

Forms persist, while matter undergoes many changes, because it is made to take on all the qualities. Imagine a statue of Achilles in bronze, and suppose it to be destroyed, and the bronze broken up into small fragments; if now some artisan collects these together, purifies the material, and by a singular science changes it into gold and again gives it the shape of Achilles, the statue will be in gold instead of bronze but nevertheless it will still be Achilles. It is just the same with the matter of our perishable and corruptible bodies, which by the art of the creator become pure and immortal. . . . A change of matter into something better is in no way incredible, for thus it is that those who are expert in the art take silver and tin, and make their appearances quite vanish, colouring them and changing them into excellent gold. Just in the same way with finely-ground sand and soluble natron people manufacture glass, something new and furnished with great brilliance.

Undoubtedly *mixtio* and the nature of the *mistum* was the central problem of early chemistry; the distinction between mixtures, compounds and elements was one which could not find any clarification until a much later time. Throughout the Middle Ages innumerable scholastic discussions took place about this question.^g Some said that

^a This was based on *Metaphys.* VII, v. 4. Cf. von Prantl (1), p. 143; Berthelot (1), pp. 76, 266, 276, 280, (2), p. 73; Festugière (1), pp. 234, 237; Leicester (1), pp. 27, 41 ff. A modern parallel might be found in the 'plasma' of the nuclear physicists.

^b The late Middle Ages here preserved one of the most ancient terms in the art, *baphē, baphikē* (βαφή, βαφική) and *bapsis* (βάψις) being the dipping of the cloth in the 'baptism' of dyeing, that technique out of which arose so many incalculable consequences. Cf. *Corp. Alchem. Gr.* III, vi, 10, III, xxxvii.

^c *Corp. Alchem. Gr.* IV, xx, 5, Comarius; also III, xxxviii, xl, Zosimus. In Berthelot & Ruelle (1), vol. 2, pp. 290, 208, 211, vol. 3, pp. 279 ff., 202, 204. On the colour symbolism see Sheppard (8). It forms the basis of that notable poem of John Donne, c. +1619, 'A Nocturnall upon St Lucie's Day, being the Shortest Day'. *Iōsis* has an alternative meaning; see below, p. 38, fn. a.

^d Cf. Hopkins (1), vii, 100, (3).

^e Unless we accept a passage in Manilius' *Astronomica* IV (c. +30), where there is mention of the *diplōsis* of gold and silver among other metallurgical-chemical arts. Scaliger thought it an interpolation, but only because of its content; Berthelot (1), p. 70, was inclined to restore it.

^f *Theophrastus*, Barth ed., pp. 71, 76; tr. Berthelot (1), p. 75; Hammer-Jensen (2), p. 79, eng. auct.

^g See Thorndike (6); Hooykaas (1, 2); Partington (7), vol. 2, p. 380. On the general nature of Aristotelianism as both basis of, and obstacle to, Western medieval scientific advance, see the interesting and revealing discussion of Schramm (1).

the forms of the components persisted in the mixture,^a and Avicenna^b was understood to think that the forms of the elements originally present coalesced into the new form, but Thomas Aquinas^c maintained a more Aristotelian position on the homogeneity of the *mistum*, saying that a new form is always imposed upon the matter of the four elements when *mixtio* occurs.^d Thus the individuality of a substance is completely lost when it is mixed or combines with something else, and the product resulting is entirely new, though it may show qualities (heat, cold, moistness, dryness, texture, colour) which depend on the components and their proportions. Jean Fernel (+1497 to +1558) believed that the forms of the elements survived unchanged and that only the qualities were mixed and equally disseminated; Francone Burgersdyck (d. +1635), however, preferred to follow Averroes^e and say that the form of the mixture was composed of the forms of the four elements 'in a remiss and altered state'.

All this was swept away by the revival of atomic theory in the +17th century, for a right conception of the nature of alloys necessarily meant the death of aurification. Once it was understood that there are simple particles and that they do not perish when mixed (or combined) 'synthetically' with others, but can be recovered afterwards 'analytically', there could be no more room for artificial golds, or 'sorts of golds' (i.e. materials with the substantial form of gold) other than gold itself. The story of the re-introduction of atomism, centering on Gassendi, Descartes and Boyle, has so often been related^f that we need say little more here, except that much was owing to Daniel Sennert (+1572 to +1637) and Sebastian Basso (+1621), who wrestled with the difficulties of Aristotelianism, and especially to Joachim Jungius (+1587 to +1657), who might be considered no less the restaurator of chemistry than of botany.^g A convinced atomist, he put forward his *hypothesis syndiacritica*, 'syncrisis' being the gathering together of different sorts of atoms, and 'diacrisis' their subsequent separation and dissipation. In a *mistum* such as an alloy the original components have not given place to something absolutely new; they remain as such, only too small to be perceived, and the *mistum* is fundamentally heterogeneous, its properties being no new substantial form but the natural effects of the components when mixed. There has been no change in their quality, only in their position. Thus it was no coincidence that Jungius was the first to give, in +1630, a complete account of the precipitation of copper from vitriol solutions in the presence of iron.^h With his work matter in the modern sense was installed in its rightful place, and no longer 'subject to the dictate of the substantial forms'.ⁱ

^a The late +7th-century Philosophus Anonymus (*Corp. Alchem. Gr.* vi, xiv, 4, 5, 6) seems to have held enlightened views on this, if Stephanides (1), p. 32, and Zacharias (1) are right.

^b Ibn Sīnā, d. +1037.

^c +1225 to +1274.

^d See also Multhaus (5), pp. 122, 149.

^e Ibn Rushd of Cordoba, d. +1198, an almost exact contemporary of Chu Hsi.

^f Cf. J. C. Gregory (1, 4); Partington (2). On the wider aspects see M. Boas (2); Greenaway (4).

^g See the new study of Kangro (1) and the discussion of Pagel (15) upon it.

^h The Chinese 'wet copper production method'; see Vol. 5, pt. 4 below. Van Helmont had preceded Jungius, it is true, in +1624, but not with so full a proof.

ⁱ Of course the revival of atomism and the understanding of the true heterogeneity of alloys was not the only factor leading to the decline of alchemy. As Dorothea Singer well pointed out (4), the macrocosm-microcosm doctrine could not long survive in the atmosphere created by the work of Copernicus and Vesalius. And the expulsion of implicit ethics from the scientific world-view meant the death of such concepts as 'perfection', for which all the metals had been supposed to be striving (cf. Gregory, 2).

Two points arise here of wider bearing on our general theme. First Berthelot was quite right to emphasise the remarkable fact that although Bolus of Mendes, Pseudo-Democritus and the others all called themselves Democriteans, the idea of atomism and explanations of chemical change in terms of atoms are never once mentioned in the whole of the Hellenistic proto-chemical aurifactive Corpus.^a Far from being Democritean, Epicurean or Lucretian, its background is composed of Orphic^b and Hermetic^c theology, Gnostic^d and Stoic^e cosmology, together with Peripatetic natural philosophy. The two former provided the cosmic models which the proto-chemical laboratory could imitate, the latter the explanation of what happened to substances on their transmutatory way to perfection. The memory of Democritus of Abdera seems by this time to have accreted a shell of magian and experimentalist tradition, so that it must have been this, and not at all his legacy of atomic philosophy, which the Hellenistic proto-chemists took as their ensign.^f Secondly, the parallel case of aurifaction in China was always immune from the destructive force of atomism, since as we know from earlier study, that doctrine was never received in Chinese intellectual circles even though introduced time after time by Indian Buddhist contacts.^g Consequently the true nature of a *mistum* or an alloy could not be known, and never did become known, in traditional Chinese culture. If one should ask, then, what took the place there of the 'Physica Peripatetica', the answer would surely be to point to several quite flexible bodies of doctrine, the operations of the forces symbolised by the *kua* or hexagrams of the *I Ching* (Book of Changes), the fundamental powers and cycles of the Yin and Yang, the generation and destruction of the Five Elements, and the specific *chhi* or *pneumata* of chemical substances.^h Thus in China just as in Europe there was a negative and a positive justification for aurifaction, though the positive ones were not the same.ⁱ One ought not to think too harshly of it. As Cyril Stanley Smith has so well said:^j

Though chemists can legitimately scoff at the alchemists' attempts at transmutation, physicists should not, even those who are unconcerned with nuclear reactions. Transmutation was a thoroughly valid aim, a natural outgrowth of Aristotle's combinable qualities, and its truth was demonstrated by every child growing from the food he ate, by every smelter who turned green earth into red copper, or black galena into base lead and virgin-hued silver, by

^a (1), p. 263.

^b Reitzenstein (1).

^c See Scott (1); Nock & Festugière (1); von Lippmann (1, 11).

^d On this component see the studies of Sheppard (1, 3, 4), and the old classic of J. C. Wolf (1).

^e As von Prantl (1) pointed out, in an interesting study now a century old. See also Kopp (1), vol. 2, p. 223, no later. The Stoic influence appears particularly clearly in the enigmas, aphorisms or epigrams, characteristic of Hellenistic proto-chemistry, which we consider in connection with Chinese thought in Vol. 5, pt. 4 below. On Stoic physics see Sambursky (1, 2, 3).

^f On Greek atomism much is to be learnt from the editor of Epicurus, C. Bailey (1).

^g Cf. Vol. 4, pt. 1, pp. 3 ff.

^h We often find such expressions as 'the *chhi* of natural gold'. On the theories of Chinese alchemy in general see the sub-section in Vol. 5, pt. 4 below.

ⁱ Elsewhere we have given reasons for declining to identify Neo-Confucian *li* and *chhi* with Aristotelian form and matter (Vol. 2, p. 475), but in any case the question is largely irrelevant, for explanations in terms of these Neo-Confucian concepts are hardly ever found in the alchemical literature.

^j (4), p. 639

every founder who converted copper into gleaming yellow brass, by every potter who glazed his ware, by every goldsmith who produced niello, by every maker of stained glass windows, and by every smith who controlled the metamorphosis of iron during its smelting, conversion to steel, and hardening. Such changes of properties, seen physically, *are* transmutations, though not (exclusively)^a chemical in the purified modern sense, and the chemistry had to be clarified before the physics could be studied. The impossibility of making real gold lay in the necessity of duplicating all of its properties simultaneously, but taken separately the malleability, reflectivity, colour, thermal conductivity, in fact practically everything but the density of gold, could be singly matched by suitable operations upon common materials. There were many examples of the validity of the aim,^b and theory taught of the combination of qualities but gave no reliable way of achieving it. Many wonderful things must have been seen by the alchemists in their mixings and heatings, more perhaps even than by the old craftsmen who sought only enjoyable aesthetic effects, but they added little to transmittable knowledge. Their symbolic language had the effect that any security system has in hampering initiates as well as outsiders, and their theories, too firmly believed, closed their eyes to many phenomena and made visible what was not there.

That the Hellenistic proto-chemists did think of themselves as followers of Peripatetic philosophy appears by a number of indications. The later commentators often speak in terms like these: 'Let us add that the oecumenical philosophers, the new savants, the exegetical expounders and commentators of Plato and Aristotle, say...', and may then enlarge on the number of solutions and heatings.^c There is also the famous if slightly enigmatic statement by Pseudo-Democritus himself: 'Yes, I also have come into Egypt, bearing (as in procession) the science of occult virtues and natural things (*pherōn ta physika, φέρων τὰ φυσικά*), so that (by the aid of a few sure principles) you may rise above desultory miscellaneous curiosity (*tēs pollēs periergeias, τῆς πολλῆς περιεργείας*) and the confusion of material phenomena (*synkechymenēs hylēs, συγκεχυμένης ὕλης*).'^d This certainly sounds like the claim of someone applying a theory to what had previously been empirical practice. Furthermore the word *eidos* occurs very often in the Corpus, as in the phrase *exetasis tōn eidōn* (ἐξέτασις τῶν εἰδῶν), 'testing the forms'.^e This is discussed in the dialogue of Synesius with Dioscorus, where the deprivation and imposition of chemical forms is expressed in words closely like those of Aeneas of Gaza already quoted, the proto-chemist being compared with the carpenter, stone-cutter and bronze-founder.^f

One may also discern Stoic influence in the Pseudo-Democritean text. The starting-material, deprived of its specific qualities by the action of heat, became a black

^a Our insertion.

^b We refrain from adding anything further here on the Western Latin theology of the eucharist, but this will come up again in a slightly different context (Vol. 5, pt. 4 below).

^c See e.g. *Corp. Alchem. Gr.* III, vi, 13, Zosimus; VI, xiv, 1, Philosophus Anonymus (Berthelot & Ruelle, vol. 2, pp. 127, 425, vol. 3, pp. 128, 406).

^d This statement follows the passage describing the vision in the temple when Ps.-Democritus evokes the spirit of his master Ostanēs, and the spontaneous opening of the column with the enigma inside. *Corp. Alchem. Gr.* II, i, 3 (Berthelot & Ruelle, vol. 2, p. 43, vol. 3, p. 45). All the variant forms of this text are assembled in Bidez & Cumont (1), vol. 2, pp. 311 ff.; cf. Festugière (1), pp. 228, 229. The name of Ostanēs the Mede does not occur in Ps.-Democritus' text as we have it now, but all the other writers of the tradition agree that he was the master referred to; see e.g. Synesius in *Corp. Alchem. Gr.* II, iii, 1, 2.

^e *Corp. Alchem. Gr.* II, i, 15.

^f *Corp. Alchem. Gr.* II, iii, 9.

molten mass, a formless *materia prima*; or, in Stoic terms, a substance 'destroyed by complete fusion'.^a Regeneration from the germ or 'seed' of perfection remaining dormant within it could then be effected, it was thought, by suitable chemical treatment, based upon the theory that reproduction of every individual type resulted from the action of all-pervasive spirit (*pneuma*), guided by its rational organising principle or generative reason (*logos spermatikos*, λόγος σπερματικός).^b Thus by the reaction of suitable chemical substances in accordance with those laws of sympathy and antipathy which were held to operate throughout the cosmos,^c it was believed that a regeneration could be brought about, aided, as in the living world, by the provision of heat and moisture and the addition at times of a small quantity of gold to reinforce the action of the seed.^d As evidence of the acquisition of fresh qualities there was the succession of colour changes, the whitening, yellowing and perhaps purpling so often mentioned (cf. p. 23); all indications of the degree of transformation undergone during the journey to metallic perfection.^e

At this point European thought swung on its orbit into a position strangely close to that which the Chinese were following. Just as Bevan noted striking ethical similarities between Stoicism and the *Bhagavad-Gītā* (-200 to +400),^f so we have often had occasion to draw attention to parallels between Stoic and Chinese thought. At various times in these volumes this has come out; we have remarked on the parallelism of seminal essence and seed (*ching*,¹ *chung*,² *tsu*),³ both in pure Chinese thought (Vol. 2, pp. 38, 481, 487) and in Buddhism (*ibid.* pp. 408, 422); as also on the parallel between the *logos spermatikos* and the Neo-Confucian principle of organisation (*li*,⁴ Vol. 2, p. 476) in every thing; and finally the parallel between wave-theory in a continuous medium (*chhi*)⁵ as conceived both by the Chinese and the Stoics, and as opposed to all atomism (Vol. 4, pt. 1, pp. 11 ff.). One might therefore ask again how far these ideas were applied to aurifaction theory in ancient China. It is difficult to say. When it comes into our field of vision in the +2nd century (cf. Vol. 5, pt. 3 below), a much greater part is played by the dualism of Yin and Yang, the play of generation and destruction of the Five Elements, and above all the forces symbolised by the *kua*⁶ (trigrams and hexagrams) of the 'Book of Changes'.^g Nevertheless *ching*, *chhi*, and even *li*, were always there; and if language and fate had made it possible for Wei Po-Yang and the Pseudo-Democriteans to hold converse together, they might conceivably have found some points of contact, or at least thought that they did so.

^a Cf. Alexander of Aphrodisias, *De Mixtione*, 216 m 14 ff., cit. Sambursky (2), p. 121.

^b Cf. Bevan (2), p. 43, (3), pp. xiii ff.

^c Festugière (1), vol. 1, pp. 198 ff., 231 ff.

^d The idea resembled in a way some modern notions such as those of catalysis and of the nucleus of crystallisation. The idea of fermentation also played a considerable part in later alchemy, for the 'little yeast that leaveneth the whole lump' was a most ancient and striking model of 'projection'. Cf. pt. 4.

^e These paragraphs were drafted in collaboration with Mr H. J. Sheppard, whose work on gnosticism and proto-chemistry (1) had emphasised the role of Stoic thought.

^f (2), pp. 69, 70, 77 ff.

^g On the theories of Chinese alchemy see pt. 4 below.

By the end of the +3rd century the theoretical aspect of aurification changed, and under the influence of Hermetic doctrine could scarcely be distinguished from a soteriological quest of a redemptive nature. The operations of metallic transformations seem to have become ritualised into an expression, primarily symbolic, of death and revivification. But this does not necessarily mean that the adepts of that time no longer concerned themselves at all with practical techniques. If one reads through the texts attributed to Zosimus, one can see that he thinks the material body of gold is nothing, that the quality of 'gold' is independent of the metallic substance which supports this spiritual quality (spiritual because conferred by the action of volatile fugacious vapours), and that this higher spirit is 'gold', furthermore that when one possesses a material in which this 'gold quality' resides (just as one might possess the essential colouring principle of a dye) one thereby has in hand what was later called the philosophers' stone, and can then 'tint into gold', in this way making 'true gold'.^a

It is interesting that there are certain actual definitions of gold in the Hellenistic Corpus, and they confirm all that has been said so far. They occur in a kind of glossary with which the principal MSS are headed, and they run as follows:^b

Gold. It is pyrite,^c cadmia,^d and sulphur.^e

Gold. Fragments and pieces of metals and minerals yellowed and brought to perfection.

Gold is what we call the white, the dry, the yellow, and (materials) tinged golden with an unfading dye.

These definitions cannot be dated with any exactness, but the 'lexicon' seems to be ancient. They must surely refer to various forms of gilding, the deposition of sulphide films on silvery metals or alloys, and the technique of surface enrichment by withdrawal (cf. p. 250); as also to the debasement of natural gold and *electrum*, and the making of brass and arsenical copper (pp. 195, 223 below). The absence of any reference to cupellation is especially significant.

A few pages earlier we made a reference to the 'tingeing' and tinting of the dyer's art. The role of textile dyeing processes in the Leiden and Stockholm papyri was examined in an important monograph by Pfister (1), the expert of the Palmyra tomb-finds.^f He found it very odd that the papyri seem to devote much more praise and attention to a number of non-fast dyes highly sensitive in colour to acidity and the mordant metal used, rather than to the very reliable light-fast indigo^g and madder.^h For example, they have much to say of 'fucus', a phycoerythrin pigment from red

^a The words here are modified from those of Hopkins (1), p. 70, cf. pp. 75, 120. The change from Cu to 'Ag' was brought about by the vapours of Hg (or As or Sb), and that from 'Ag' to 'Au' by those of S.

^b *Corp. Alchem. Gr.* 1, ii (Berthelot & Ruelle, vol. 3, pp. 16, 17), discussed by Berthelot (2), p. 20.

^c Berthelot (2), p. 257. Equivalent to 'marcassite', any metallic (or semi-metal) sulphide.

^d Berthelot (2), pp. 239 ff. Natural or furnace calamine (zinc carbonate or oxide).

^e Berthelot (2), p. 267.

^f Cf. Sect. 31. Wool was the cloth most in question.

^g From *Isatis tinctoria* in Europe, not the *Indigofera tinctoria* of India and China. In Greek it was *anthrax* (ἀνθραξ). The latter must have been sometimes imported, as the Stockholm Papyrus mentions woad from India.

^h *Rubia tinctorum* or *R. peregrina* in Europe. The Chinese species was *R. cordifolia*, and some of the Chinese silk fibres found in the Palmyra textiles were dyed with it. In Greek *rhizēs* (ρίζης), madder is the most light-fast natural red dye known.

seaweeds,^a as also alkanet or 'dyer's bugloss',^b together with the colouring matters of the fruits of *Arbutus*, *Rhamnus* and *Carthamus* species. This was all the more strange because of Pfister's own archaeological researches on the textiles of Syria and Egypt from the +3rd to the +7th centuries, in which it was possible to show chemically that the most usual dyes were in fact madder and kermes^c for red, mixtures of madder and indigo for purple (if of course the expensive mollusc murex^d was not itself used), indigo for blue, and mixtures of indigo with various yellow dyes for green. Similarly it seemed to him very peculiar that the recipes for false gems made use mostly of superficial coloured varnishes which presumably anyone could unmask by scratching with the nail, ignoring the good frits and coloured glasses and enamels which the Egyptian artisans had been making for centuries.

All this led Pfister to the conclusion that the papyri, though containing some sober craft recipes, were not on the whole workshop handbooks, nor manuals of fraudulent practitioners either. He saw them as the productions of dilettante philosophers much more like Pseudo-Democritus himself, dazzled by the colour-changes which dyes would undergo under different chemical conditions, and not seriously intending to fool anybody by their many different kinds of 'false purples'. Here we find him difficult to follow, not because of any doubt that the ancient dyeing techniques were at the basis of Hellenistic proto-chemistry, which assuredly extended the idea of their colour mastery to gems, and also so significantly to metals; but because the metallurgical parts do clearly show an intent to deceive, and could actually have done so, especially as the artisans were well aware of cupellation and must have known that the test of the refiner's fire was not to be applied. For that matter, indigo-madder combinations could surely have been passed off as true Tyrian molluscan purple—it would depend what the merchant said. Finally one must beware of basing too much on negative evidence. The papyri as they have come down to us are few and fragmentary, and in the material that has been lost for so long the writers may well have said more of the light-fast dyes and of the uniform-substrate coloured glasses. For all the interest of Pfister's work, which remains one of the most satisfying pieces of chemical archaeology, the contrast between the quasi-artisanal papyri^e and the philosophical proto-chemistry of the Corpus remains striking and indubitable.

^a *Phykos* (φύκος) was most probably from *Rytiphloea tinctoria*, but many of the red algae will work in this way.

^b From the roots of *Anchusa tinctoria*, allied to borage, which gets its name from the Greek *anchousa* (ἀγχούσα). Alkanet is from Ar. *himma' al-ghālah*.

^c A coccid insect, in Europe *Kermes vermilio* of Levantine habitat, parallel with the cochineal insect of Mexico, *Dactylopus coccus*. In Greek *kokkon* (κόκκον); in Ar. *qirmiz*, from Pers.

^d The famous *Murex brandaris*, on which one may consult W. A. Schmidt (1); Lacaze-Duthiers (1); and Dedekind (1). Friedländer's discovery in 1909 that the pigment is 6,6'-dibromindigo (1) was a classical meeting-point of comparative biochemistry and the history of technology.

^e We are inclined to put it this way because the people of the papyri were certainly not artisans in the ordinary sense. To begin with, they were literate, as those were not, and their great interest lay in the techniques of imitation of all the most precious things—stuffs, gems, metals—the stock-in-trade of those others, with cheaper materials. No doubt they joined with the philosophers of the Corpus in a fascination with the colour phenomena of chemical change; where they parted from them was in their conviction that the imitation was different from the real thing. One thinks of them as almost Vincian in character, analogous in their way to the higher artisanate of the Renaissance (cf. Vol. 3, pp. 154ff.), with an expertise quite distinct from what the gentlemen-scientists would later make of it.

(ii) *The persistence of the aurifactive dream*

As we have seen, the Aristotelian theories could not survive the re-introduction of atomism in +17th-century Europe. But aurifaction and alchemy were not immediately killed by this, and it will therefore be worth while, especially for comparison with the Chinese developments which form the body of this Section, to trace very briefly the alternations of denial, scepticism, hope and faith in Arabic and Western thought, and to mark how far into modern times the aurifactive dream was capable of persisting.^a

In the Arabic texts all kinds of views are of course represented, but some among them were strikingly forward-looking. For example, in one of the books of the Jābirian Corpus, dating from the neighbourhood of +900, there is the following passage:^b

When mercury and sulphur combine to form a single substance, it has been thought that they have essentially changed, and that an entirely new substance has been formed. The fact is otherwise, however. Both the mercury and the sulphur retain their own natures—all that has happened is that their parts have become attenuated and in close approximation to one another, so that to the eye the product appears uniform. But if one could find an apparatus to separate the parts of one sort from those of the other, it would be apparent that each of them has remained in its own permanent natural form and has not been transmuted or changed. We say, indeed, that such transmutation is not possible for natural philosophers.

This belongs to the element in the Jābirian Corpus which was conscious of the Greek atomic theories, and if it had been taken seriously would have struck at the root of aurifactive belief, but the *Physica Peripatetica* was much too strong for that. Nevertheless other Muslim scientific men took very sound views on aurifaction, notably Ibn Sīnā,^c whose influence in the later medieval West was great. In +1022 he wrote:^d

As for the claims of the alchemists, it must be clearly understood that it is not in their power to bring about any true change of (metallic) species. They can, however, produce (excellent) imitations, tingeing the red (metal, i.e. copper) white so that it closely resembles silver, or tingeing it yellow so that it closely resembles gold. They can also tinge the white (metal) any colour they desire, until it bears a close resemblance to gold or copper; and they can free the leads (i.e. tin and lead) from most of their defects and impurities. Yet in these (products) the essential nature remains unchanged; they are merely so dominated by induced

^a Having called Hellenistic proto-chemistry 'alchemy', Hopkins dubbed the ideas of the Latin Middle Ages 'pseudo-alchemy' or even 'false alchemy' (1), pp. 164ff., 192ff., 212, on the ground that while the Hellenistic proto-chemists had obtained very real results with their 'tingeings', the claims of the late Western alchemists (from the +12th to the +17th centuries) to produce gold with all its range of properties from other substances depended on fraud, pretence, or simple faith. It is true that the Arabic and medieval Latin Western dream of making real gold from other atomic structures was as futile as the ceaseless fluttering of moths trapped behind window-panes (so long as nuclear physics had not been born), and that the Hellenistic and Chinese aurifactors did produce many artificial 'golds'. But we would not like to follow Hopkins in his terminology, for the late Western adepts had another aim also in mind, that of preparing an 'elixir of life', which made them true alchemists in our sense, and in so far as they demonstrated effects based on self-deception, they were aurifactors still.

^b Tr. Holmyard (2), from the *Kitāb al-Khawāss al-Kabīr* (Book of Properties).

^c At least in his maturer years, for two tractates seemingly written when he was young have been found and translated by Stapleton, Azo, Husain & Lewis (1); if these are genuine he must at first have believed fully in the possibility of aurifactive transmutation.

^d In the *Kitāb al-Shifā'* (Book of the Remedy), tr. Holmyard & Mandeville (1), p. 41; Partington (3). Cf. Hopkins (1), p. 179; Leicester (1), p. 70.

qualities that errors may be made concerning them, just as it happens that men are deceived by salt, qalgand, sal ammoniac, etc.^a

I do not deny that such a degree of accuracy may be reached as to deceive even the shrewdest, but the possibility of eliminating or imparting the species difference has never been clear to me. On the contrary I regard it as impossible, since there is no way of splitting up one combination (of properties) into another.

Though sometimes paradoxically attributed to Aristotle himself,^b this formulation of Avicenna was widely known in medieval Europe, and the words *Quare sciant artifices alkimie species metallorum mutare non posse* remained a rock of offence for the believers during half a dozen subsequent centuries. On the other hand a Pseudo-Avicenna also circulated, the *De Anima in Arte Alchemiae*, a work probably compiled in Spain from miscellaneous Arabic originals around +1140; this was influential on Roger Bacon^c and constantly quoted by the +13th-century encyclopaedists.^d It favours the reality of transmutation, and although detailing seven tests for true gold, including the cupel, says that the best gold is that made by the philosophers' stone, yet admitting that some aurifictors make false gold and silver.^e

This contradiction led to continuing uncertainty, and the polymaths like Albertus Magnus could answer only with a 'perhaps'. Thus in his *De Mineralibus et Rebus Metallicis*, written about +1242, Albert says:^f

The best of all alchemical operations are those which follow the way of Nature herself, namely a purification of sulphur and mercury and a mixing of these with the matter of metals, for by these forces is every metal generated. But those who whiten with white tinctures and yellow with yellow ones, without changing the metallic species, are deceivers, and do not make true gold and silver; and all of them work partly or wholly like this, for I have had alchemical gold and silver that came into my hands tested, whereupon it withstood six or seven heatings, yet upon stronger firing it was at length consumed and lost, reverting in the end to dross. Yet just as physicians by medicines first purge away corrupt matter and afterwards restore to health, so skilful alchemists work with a great mass of the matter of mercury and sulphur, which are the constituents of metals, and then combine them in due proportions of elementary and celestial virtues for the metal which they wish to obtain; for what can be done in Nature's vase can perhaps be done in the vase of Art, and what Nature does by the heat of the sun and the stars can be accomplished (perhaps) by the heat of the Art.

Standing between the experienced goldsmiths on the one side and the aurifactive alchemists on the other, Vincent of Beauvais shows the same vacillation. In the *Speculum Majus* (c. +1255) he says:^g

Alchemy may to some extent be false, yet ancient philosophers and artisans in our own time have proved it partly true. . . . Some tincture white (metal) to a yellow so that it seems to be gold, and remove the impurities of lead so that it looks like silver—and though it will always be lead they produce it with such qualities that men may well be deceived thereby.

^a The difficulty of identifying salts at that time was of course very great.

^b The text sometimes had the title *De Mineralibus Aristotelis*, or *De Congelatione et Conglutinatione Lapidum*.

^c D. Singer (2).

^d Cf. Partington (3), who gives references to Ruska's work on this text.

^e The book is described in Berthelot (10), vol. 1, pp. 293 ff.

^f Tr. Ganzelmüller (2), p. 77; Partington (3), p. 11.

^g Cit. Hopkins (1), p. 168.

But as long as Aristotelian philosophy continued dominant the alchemists could always win, providing no one insisted (like Albert) on a cupellation test. In Islam it was the same as in Christendom. Aḥmad al-'Irāqī, who wrote just before +1300 a 'Book of Knowledge acquired concerning the Cultivation of Gold', continued the old doctrine of prime matter and the deprivation and imposition of forms, even interpreting as a transmutation the silver remaining after the cupellation of argentiferous lead.^a And one of the early +14th-century tractates of the Villanovan Corpus perpetuates the view that 'there is only one first matter of the metals. According to a natural action, varying with the degree of heating, it clothes itself with different forms.'^b

Contemporary with the atomist theoreticians already mentioned (p. 24) were the great +16th-century metallurgists, Biringuccio, Agricola, Ercker, and it need hardly be said that none of them had any use for aurifaction.^c But many greater names were much more equivocal, and of these we may select two—Francis Bacon and Isaac Newton. However severe the former was in some places, he did in fact reckon the making of gold to be possible, as we can see in an interesting passage in which he mentions Chinese alchemy. One saying of his is very well known, and to this day a fair judgment on the whole movement from Hellenistic times onwards. In the *Advancement of Learning* (1605) he wrote:^d

The sciences which have had better intelligence and confederacy with the imagination of man than with his reason, are three in number: astrology, natural magic, and alchemy; of which sciences, nevertheless, the ends or pretences are noble... Alchemy pretendeth to make separation of all the unlike parts of bodies, which in mixtures of Nature are incorporate. But the derivations and prosecutions to these ends, both in the theories and in the practices, are full of error and vanity; which the great professors themselves have sought to veil over and conceal by enigmatical writings, and referring themselves to auricular traditions and such other devices, to save the credit of impostures—and yet surely to alchemy this right is due, that it may be compared to the husbandman whereof Aesop makes the fable; that, when he died, told his sons, that he had left unto them gold buried under ground in his vineyard; and they digged over all the ground, and gold they found none; but by reason of their stirring and digging the mould about the roots of their vines, they had a great vintage the year following: so assuredly the search and stir to make gold hath brought to light a great number of good and fruitful inventions and experiments, as well for the disclosing of Nature, as for the use of man's life.

And elsewhere in the same book he thought aurifiction much more possible than aurifaction.

For it is a thing more probable, that he that knoweth well the natures of weight, or colour, of pliant and fragile in respect of the hammer, of volatile and fixed in respect of the fire, and the rest, may superinduce upon some metal that nature and form of gold by such mechanic as belongeth to the production of the natures afore rehearsed, than that some grains of the medicine projected should in a few moments of time turn a sea of quicksilver or other material into gold. So (also) it is more probable, that he that knoweth the nature of

^a Holmyard (5), on the *Kitāb al-'Ilm al-Muktasab fī Zīrā'at al-Dhahab*. Cf. Vol. 5, pt. 4 below.

^b Hopkins (1), p. 164.

^c There is a special treatment of this point by Lange (1). Cf. Pantheo's *Voarchadumia* (+1530).

^d *Works*, ed. Montagu, vol. 2, p. 44.

arefaction,^a the nature of assimilation of nourishment to the thing nourished, the manner of increase and clearing of spirits, the manner of the depredations which spirits make upon the humours and solid parts, shall by ambages of diets, bathings, anointings, medicines, motions, and the like, prolong life, or restore some degree of youth or vivacity, than that it can be done with the use of a few drops or scruples of a liquor or receipt.^b

Here Bacon's words on the 'elixir of life' were very apposite to the physiological alchemy of China (see Vol. 5, pt. 5 below), though of course he can have known nothing at all of this. What he did know about the Chinese concerned their argentification, of which he wrote with approval in *Sylva Sylvarum, or Natural History in Ten Centuries* (1627):

The world hath been much abused by the opinion of making of gold: the work itself I judge to be possible; but the means hitherto propounded to effect it are, in the practice, full of error and imposture, and in the theory, full of unsound imaginations. For to say, that Nature hath an intention to make all metals gold; and that, if she were delivered from impediments, she would perform her own work; and that, if the crudities, impurities, and leprositities of metals were cured, they would become gold; and that a little quantity of the medicine, in the work of projection, will turn a sea of the baser medicine into gold by multiplying:^c all these are but dreams; and so are many other grounds of alchemy. And to help the matter, the alchemists call in likewise many vanities out of astrology, natural magic, superstitious interpretations of Scriptures, auricular traditions,^d feigned testimonies of ancient authors, and the like.

It is true, on the other side, they have brought to light not a few profitable experiments, and thereby made the world some amends. But we, when we shall come to handle the version and transmutation of bodies, and the experiments concerning metals and minerals, will lay open the true ways and passages of Nature, which may lead to this great effect.^e

And we commend the wit of the Chineses, who despair of making of gold, but are mad upon the making of silver: for certain it is, that it is more difficult to make gold, which is the most ponderous and materiate amongst metals, of other metals less ponderous and less materiate, than *via versa* to make silver of lead or quicksilver, both which are more ponderous than silver; so that they need rather a further degree of fixation than any condensation. In the mean time, by occasion of handling the axioms touching maturation, we will direct a trial touching the maturing of metals, and thereby turning some of them into gold: for we conceive indeed, that a perfect good concoction, or digestion, or maturation of some metals, will produce gold.^f

Thus in spite of everything that Jungius and the atomists had been able to do, the great 'Bell that call'd the Wits together' went on record in favour of aurifaction.^g

^a I.e. drying processes.

^b *Works*, ed. Montagu, vol. 2, p. 147.

^c Note the longevity of the idea of *diplosis* (p. 18 above).

^d In Chinese alchemy we shall find the importance of oral tradition emphasised over and over again (Vol. 5, pt. 3).

^e Francis Bacon never lived to do this, as he died early in +1626, and the book was published by his chaplain, W. Rawley.

^f *Works*, ed. Montagu, vol. 4, pp. 159, 160. Bacon's point about the density was further developed in a tractate entitled *Historia Densi et Rari necnon Coitionis et Expansionis Materiae per Spatia* also posthumously published, in +1638 (*Works*, ed. Montagu, vol. 10, p. 283). This included a famous table of specific gravities of the metals. Such density lists had been included in Chinese mathematical books much earlier, e.g. the *Sun Tzu Suan Ching* (see Vol. 3, p. 33). We are indebted to Miss Barbara Flood for bringing these passages to our attention.

^g On alchemy and chemistry in Bacon's work as a whole see the papers of West (1) and Gregory (3). On his general position, Rossi (1).

By now it is generally known that Isaac Newton, with Galileo the very founder and paragon of modern exact science, was a deeply interested student of alchemy and an active laboratory worker for a large part of his life, leaving a mass of manuscripts on the subject still extant but not yet thoroughly described.^a A large part of this material consists of excerpts copied from such alchemical writers as Flamel, Ripley, Sawtre, Sendivogius and Maier, from the +14th to the early +17th centuries. Newton even read such quasi-Arabic medieval texts as the *Consilium Conjugii*.^b He must have been all the more in tune with the mystical and Hermetic style of these writers because he had grown up in a university dominated intellectually by the Cambridge Platonists, men such as Henry More, Ralph Cudworth and Benjamin Whichcote.^c Already in +1667, before his election as a Fellow of Trinity College, and soon after the time when at the height of his powers he had conceived the theory of universal gravitation, he was making chemical experiments privately; and between +1678 and +1696, after he had become (as quite a young man) Lucasian Professor of Mathematics (1669), he spent a great deal of time in his own laboratory at the College.^d This was the period when he composed his comprehensive work on the motion of bodies (*De Motu Corporum*, 1685); and the *Principia* itself appeared in +1687. His assistant, Humphrey Newton (not a close relation), afterwards recorded that he

rarely went to bed before 2 or 3 of the clock, sometimes not till 5 or 6... especially at spring and fall of the leaf, at which time he used to employ about six weeks in his laboratory, the fire scarce going out either night or day, he sitting up one night and I another, till he had finished his chemical experiments, in the performance of which he was most accurate, strict and exact...^e He would sometimes, tho' very seldom, look into an old mouldy book wch. lay in his laboratory, I think it was titled *Agricola de Metallis*, the transmuting of metals being his chief design, for which purpose antimony was a great ingredient.

Fortunately a good deal of material constituting records of his own experiments has survived in the Newton MSS, and from this we find that what he was particularly interested in was the possibility of decomposing metals, the properties of their chlorides, and the preparation of alloys of the utmost fusibility.^f Newton was probably not himself an alchemist in the medieval sense, i.e. a positive believer in aurifaction, but

^a See Sherwood Taylor (10); Geoghegan (1). Work is in active progress on the MSS, which run from +1676 onwards almost until he left Cambridge. Newton's library, rich in alchemical books, has been described by Feisenberger (1).

^b *Consilium Conjugii, seu de Massa Solis et Lunae libri III, ex arabico in latinum sermonem reducti*; see Berthelot (10), vol. 1, p. 249; Ferguson (1), vol. 1, p. 176, who consider it not earlier than the +14th century, and doubt that it had any Arabic original. Nevertheless the idea of a 'ferment of gold and silver' is very ancient, indeed Hellenistic; see Berthelot (2), pp. 31, 57, 209, 210, 257, 304, and Vol. 5, pt. 4.

^c Cf. Vol. 2, pp. 503ff. The point was made, e.g. by Forbes (26), and elaborated in McGuire & Rattansi (1). See also Rattansi (3, 4); Westfall (1); Walker (3) and the book of Yates (3).

^d See the accounts in Gunther (4), pp. 40ff., 220ff.; Partington (7), vol. 2, pp. 468ff. It must have been in the little garden to the right of the Great Gate as you enter it, for his rooms were certainly between that and the Chapel, and it adjoined them.

^e An interesting statement, for as we now know from his own laboratory notes, Newton was meticulous in weighing, and keeping track of proportions.

^f Boas & Hall (2). This was presumably because he wanted to follow out the volatility of metallic compounds, and to explore the vexed question of the 'mercury of metals'. To this day, a fusible alloy of lead, tin and bismuth, melting at 94.5°, is known as Newton's metal. Cf. Table 102.

he lived at a time when it simply could not be ruled out of court, a time when transmutation was still a valid possibility, unaffected by the Lavoisierian and Daltonian concepts of atoms, elements and compounds;^a he was therefore an alchemist much as Libavius and Becher had been, one who studied the traditional writings assiduously, carried out systematic experiments in the manner of a modern chemist but expressed himself in the old time-honoured technical language, and kept an open mind concerning transmutation and aurification itself.^b At this time Newton must have known Giovanni Francesco Vigani, a skilled practical chemist, metallurgist and pharmacist from Verona in Italy, who began to teach these sciences in Cambridge in +1683 or soon afterwards, first at Queens' and St Catharine's, then later at Trinity, where 'an elegant chymical elaboratory' was fitted up for him by the Master, Richard Bentley, in +1703, the year in which the University appointed Vigani its first Professor of Chemistry.^c But this was after Newton had moved to London in +1699 to be (of all things) Master of the Mint,^d and the same year as that in which he became President of the Royal Society. Earlier, in +1692, he had been much concerned, with Robert Boyle and John Locke, about a project for 'multiplying gold', but in the end nothing came of it.^e As for Newton's chemical reputation, it rests largely on some of the 'Queries' which he added to his *Opticks* (+1704 and +1717), by which time he was intent on exploring the explanatory possibilities of the corpuscularian hypothesis. So far did he carry this that he came very near to stating what today we should call the levels of sub-atomic particles (protons, electrons, etc.), atoms themselves, and the molecules which they form.^f His aim was certainly to compass the extremes of size in the universe, from the minutest particle to the galactic scale, even though it was not possible for him to achieve it. At the same time he was occupied, almost throughout his life, with deep if unorthodox studies in theology,^g the interpretation of the Hebrew prophetic books, biblical archaeology and ancient chronology.^h It has also been shown that even in his most creative physical and cosmological work he felt that he was only recovering a *prisca sapientia* which the ancient sages and prophets (Pythagoras, Democritus, Solomon, Moses, Moschus the Phoenician) had possessed yet hidden in parable and symbol.ⁱ A similar motive must also have had some share in his alchemical

^a It seems clear that Newton believed, at least for many years, that the 'wet copper method' (cf. p. 24 and Vol. 5, pt. 4) was a real transmutation of iron into copper, in spite of van Helmont and Jungius (Partington (7), *loc. cit.*).

^b On the connection of his alchemical interests with his system of Nature, see also Newall (1); McKie (1); Rattansi (2). On his physics in relation to later developments in chemistry see Thackray (1); McGuire (1, 2).

^c See Gunther (4), pp. 221 ff.; Partington (7), vol. 2, pp. 686-7; Peck (1). Vigani died at Newark in +1713. He was the author of a small textbook entitled *Medulla Chymiae* (1682). His laboratory was not the same as Newton's but further west, looking down the bowling-green to the river.

^d He was made Warden in +1697 and Master in +1699 (Craig, 1, 2). At the Mint he carried out many assays personally, giving evidence of great manual dexterity, so he would never have been deceived by aurification.

^e Partington (7), vol. 2, pp. 470-1; Forbes (25).

^f Vavilov (1); Forbes (26).

^g McLachlan (1).

^h Manuel (1).

ⁱ McGuire & Rattansi (1); Walker (2). This was part of the great liberal Hermetic and Platonic tradition in Christian thought. One might draw attention here to the paper of Walker (1), who shows that the work of the 'figurist' Jesuits of the China mission (Louis Lecomte, Charles le Gobien, Joachim Bouvet, Joseph de Prémare, J. F. Fouquet) was one of the last phases of enthusiasm for the

diligence. Thus Newton has been called the last of the magi as well as the first modern physicist,^a and though this judgment has been thought exaggerated it enshrines a truth of cardinal importance for all comparisons between the sciences of East and West. In weighing the contributions of such alchemists as Mêng Hsü, Chhen Chih-Hsü or Chu Chhüan, let us not forget that aurifaction was still at times a live issue for the greatest single mind in the rise of the modern scientific movement of the West.

(2) THE ARTISANS' CUPEL AND THE ENIGMA OF AURIFACTIVE PHILOSOPHY

This is where we return to the entrance of the maze and start off again in a second direction. To restate the case more widely and more explicitly, it seems to us that in every Old World civilisation there were essentially two groups of people involved, on the one hand artisans who knew and practised the test of cupellation, and were capable of making artificial golds which they were well aware would not withstand it (aurifaction); and on the other hand the philosophers who defined gold so as to include their artificial preparations, and either did not know of cupellation or ignored it, rejecting its validity (aurifaction). In Hellenistic Egypt and neighbouring times and places this contrast is signalised quite sharply by the papyri versus the Corpus; in Han China and the East Asian culture-area it is mirrored in the artisans of the Imperial Workshops (Shang Fang¹) who detected the frauds of -144 (cf. p. 12) and demonstrated the failures of Liu Hsiang about -56 (cf. p. 48), as compared with the Taoist *fang shih*² from Li Shao-Chün onwards (p. 13) who carried on their macrobiotic aurifactions. As long as cupellation was not applied, the mages could get away with anything. But what is cupellation? And how far back in history can we trace its use?

Although in the present context one thinks of it primarily as a test for the purity and authenticity of true gold, cupellation naturally arose from the process of extracting it from its ores and refining it. Assaying is only refining on a reduced scale. Gold or silver, with or without other metals, is heated with lead in a vessel made of bone-ash, a crucible or shallow hearth, set in an oxidising furnace with a muffle and reverberatory heat-flow. Lead monoxide (litharge) is formed, as well as the oxides of any base metals, and these separate with any other impurities, soaking into the porous ash and being blown off in the fumes, until a cake or globule of the precious metal remains.^b This is 'ancient theology'. The Chinese classics no less than the pagan philosophies of the Mediterranean world had prophesied the coming of Christ. All this in the end contributed to the rise of comparative religion, on which the book of Manuel (2) is to be read.

^a Keynes (1), in a famous study. But we need not think of Newton as a 'split personality'; he was probably using alchemical along with mathematical and astronomical methods in the search for a unified science of Nature.

^b Cf. Mellor (1), p. 386; Sherwood Taylor (4), pp. 31, 35; Berthelot (2), pp. 35, 38, 39; Gowland (2, 3, 6). The cupellation of gold is mentioned by Aristotle (*Meteorologica*, IV) as an example of *hepsēsis* (ἐψῆσις) or 'boiling'; Düring (1), p. 38. Ogden (1) describes a famous fresco in the Casa del Vetti at Pompeii showing the process in a mint worked by *amorini*. The hearth material of a Roman silver refinery of the 3rd century at Silchester, contemporary with the papyri, was analysed by Gowland (8), who reconstructed it with the help of his knowledge of the traditional process in Japan (Fig. 1300). The systematic recovery of silver from argentiferous lead was a Roman practice (Friend & Thorneycroft, 1).

¹ 尚方

² 方士



Fig. 1300. Extraction of silver from argentiferous lead by cupellation in Japan, a drawing of late date but traditional character from Masuda Tsuna's *Kodō Zuroku* (1801), p. 7a; reproduced by Gowland (2, 12).

the 'refiner's fire', but it will not separate silver from gold (a process for centuries called 'parting'),^a which is why so much of the early Mesopotamian and Egyptian gold is really *electrum*, the alloy of the two metals.^b The ancient method of separation is called 'dry parting' or 'cementation'.^c Common salt and brick-dust or clay with

^a There is an excellent historical note on this in Hoover & Hoover (1), pp. 458ff., though a little outdated now in some respects.

^b Partington (1), p. 232; Quiring (1), fig. 21.

^c Cf. the cementation of wrought iron to steel, discussed in Sect. 30, but there it is a question of putting carbon in, instead of drawing metals out as chlorides. The iron oxide, derived from the sulphate, assists oxidation and chloride formation at the right stages. The 'wet copper method' (pp. 24, 35) and its analogues are also sometimes called cementations. So also is brass-making (pp. 195ff.) and arsenic-plating (p. 241).

'vitriols' (copper and iron sulphates), are packed around; then on strong heating chlorides of the metals are formed, including the silver but not appreciably the gold, and these volatilise or are absorbed like the oxides by the ash of the cupel, leaving a cake or button of pure gold.^a It will be evident that this process could also be used for the surface enrichment of a gold-containing alloy by the withdrawal of copper and



Fig. 1301. Surface enrichment of gold alloys, the 'colouring' of coins by a form of cementation in a Japanese mint; a drawing of late date but traditional character reproduced by Gowland (6, 12).

silver from the external layers, so that an object thus treated would give a positive test to the touchstone, as the Hellenistic artisans certainly knew.^b 'Wet parting' or 'quartation', by the use of nitric acid (*aqua fortis*) or nitric and hydrochloric together (*aqua regia*), was presumably unknown to any ancient or early medieval people, since the discovery of the strong mineral acids has to be placed towards the end of the +13th century in Europe.^c Thirdly, separation could be made by 'sulphurisation', converting the silver but not the gold into its sulphide by heating with sulphur, and then removing the black silver sulphide, from which (if not needed for *niello*)

^a Cf. Berthelot (2), pp. 13 ff., 15, from another Leiden papyrus, V, which calls it *iōsis* (rusting, or as we should say, oxidation); also pp. 31, 42; Bergsøe (2); Sherwood Taylor (4), p. 34; Aitchison (1), vol. 1, p. 173, vol. 2, p. 312; Gowland (2, 6, 7, 12), who saw it done in Japan. Pliny describes the process, *Nat. Hist.* xxxiii, xxv, 84, recording medicinal virtues in the dross, which may have been remembered later on when the idea of a potable gold elixir came West. But of course the salt in it would have been silver chloride, not any derivative of gold.

^b Papyrus X, nos. 20, 20a; cf. Berthelot (2), pp. 34, 55 ff., 58, 71, on Ps.-Democritus. Cf. Fig. 1301.

^c Cf. Vol. 5, pt. 4 below.

silver could be recovered by cupellation with lead in the ordinary way. But this method seems to be mentioned no earlier than the first half of the +12th century.^a Finally, there was another way of separating gold from silver, by the use of stibnite (naturally occurring antimony sulphide); here again the melt forms two layers, the upper one containing the sulphides of silver and any base metals present, so that instead of being removed as the chloride^b or the nitrate, the silver is once more got rid of as the sulphide. Below there is gold with metallic antimony, and the latter is driven off by further heating afterwards.^c This was not described in the West until the end of the Middle Ages,^d but there are hints that it may have been known and used in ancient times.

Assaying has been practised since remote antiquity, the process of cupellation having a longer continuous history than any other quantitative chemical process still surviving.^e Men weighed what went in and weighed again what came out. Since the history of this is so well known it would be superfluous to give an abundance of instances here, but the general picture of what has been established by archaeology and history may be gained from a few. Already in the early -14th century (corresponding to Shang times), Burraburiash, king of Babylon, was complaining to Amenophis IV of Egypt about the poor quality of the gold which had reached him—'of 20 minas only 5 remained after being put in the fire'.^f Yet the purity of -4th-millennium Mesopotamian gold reaches as high as 91%,^g and deliberate alloys of gold and copper are mentioned in Ur III texts (-1900).^h Evidence from inscriptions suggests that gold was being refined in Egypt from at least -1200,ⁱ and by -500 a figure of 99.8% purity was attained, well above any possible naturally occurring product.^j There are

^a It is in Theophilus Presbyter's *De Diversis Artibus* (c. +1125), III, 70; Hawthorne & Smith ed., p. 147, Dodwell ed., p. 128. Possibly it was an Arabic invention and may have come from al-Kathī (+1034); cf. Ahmad & Datta (1) and Vol. 5, pt. 4 below.

^b It is interesting that chlorine is still used as a parting agent, being pumped as a gas into molten bullion. This process was first described by L. Thompson in 1833 and first applied by F. B. Miller in Australia in 1867.

^c Cf. Berthelot (2), p. 264; Sherwood Taylor (4), p. 35; Hoover & Hoover (1), pp. 451, 461, commenting on Agricola, *De Re Metallica*, ch. 10.

^d It appears in the first *Proberbüchlein*, c. +1520. In later times refiners developed many hybrid methods between the salt, sulphur and antimony sulphide techniques (Hoover & Hoover, *loc. cit.*).

^e See the monograph of Greenaway (1) and his papers (2, 3). We are much indebted to Mr F. Greenaway for placing a copy of his unpublished typescript at our disposal.

^f Levey (2), p. 187; Forbes (3), p. 155. This is in the Tel el-Amarna correspondence; Burraburiash r. -1385 to -1361.

^g Levey, *loc. cit.* Forbes (3), p. 156, places the beginnings of gold refining in the first half of the -2nd millennium, but (p. 213) the invention of cupellation for purifying silver about a millennium earlier; both in the neighbourhood of Asia Minor. That was the region, probably, which gave rise to the later technical terms (Gr.) *obrysa* (ὀβρυσα), forming (Lat.) *obrussa* and post-classical *obrysa*, 'test' (of gold) or 'tested' (gold), terms which Benveniste (1) has recognised as meaning cupellation and cementation, from the actual cupel in which the process was carried out. For (Hittite-Hurrian) *hubrušhi* meant a clay or earthen vessel or container. The probability of a loan of this kind is enhanced by the fact that the very word for gold itself (Gr.) *chrysolos*, χρυσός, is probably of Hittite-Hurrian origin, *hiaruhhe*, doubtless through some Phoenician intermediary form which would have been something like Hebrew *hārūs*.

^h Old Babylonian tablets, Levey, *op. cit.* p. 188.

ⁱ Lucas (1), pp. 257ff., 262ff.

^j Aitchison (1), vol. 1, p. 167; Lucas (2). There seem to be hardly any analyses of ancient Chinese gold and silver objects, studies on which have been mainly confined to art history; H. Ling Roth (1); Andersson (8); cf. Gyllensvärd (1).

Old Assyrian statements of refining losses in silver-working about -1800, specifications of alloy fineness,^a and even a Sumerian distinction between the two sorts of loss (litharge volatilisation and the absorption of the base metal oxides by the cupel), for there were two stages in the refining (*tubbu* and *patāqu*).^b There is no positive evidence in ancient Mesopotamia for the salt cementation method for parting, though its use can be inferred, and the mention of it in the Babylonian Talmud (+3rd century) may be an indication of a long tradition.^c Other ancient cultures for which object analyses and archaeological finds have brought evidence of cupellation are Troy II (c. -2000)^d and Mycenae (c. -1500), while in the latter case the presence of antimony in silver objects might suggest the use of the stibnite method.^e In Nabonidus' time (mid -6th century) gold and silver were being regularly assayed by cupellation in Southern Mesopotamia,^f but references can be found in the literatures of all contemporary cultures. Indeed, the biblical ones so familiar to us would in some cases be earlier, e.g. the 'dross of silver' in Isaiah (c. -720)^g and Ezekiel (c. -580),^h or Jeremiah's 'the bellows blow fiercely, the lead is consumed in the fire' (c. -620).ⁱ So also there is the famous passage in Malachi:^j

But who may abide the day of his coming, and who shall stand when he appeareth? For he is like a refiner's fire and like fuller's soap, and he shall sit as a refiner and purifier of silver, and he shall purify the sons of Levi and purge them as gold and silver.

And 'The fining pot is for silver and the furnace for gold, but the Lord trieth the hearts'.^k It would seem that everywhere in the Old World cupellation was known.^l From the -8th century onwards the Phoenicians were using it at the Rio Tinto mining region in Spain,^m only recently the -6th-century gold refinery of Croesus at Sardis in Lydia was unearthed by a Harvard-Cornell archaeological expedition,ⁿ and

^a Levey (2), pp. 180ff.

^b *Op. cit.* pp. 182-3, 192. The second stage was at a higher temperature.

^c *Erubim* (B), 53b, cit. Levey (2), p. 192. Cf. Partington (1), pp. 27, 36, 46.

^d Partington (1), p. 343; Roberts [-Austen] (1).

^e Partington (1), p. 351; Blümner (1), vol. 4, p. 151.

^f Many cuneiform inscriptions; Levey (2), pp. 190ff. Nabonidus r. -555 to -538. Cf. Meissner (1), vol. 1, pp. 269, 356; Strassmeier (1, 2); Partington (1), pp. 233, 237.

^g Isa. i. 22, 25.

^h Ezek. xxii. 18ff., 22.

ⁱ Jer. vi. 28-30.

^j Mal. iii. 2, 3, iv. 1.

^k Proverbs xvii. 3, cf. xxvi. 23, xxvii. 21. See also Num. xxxi. 23 and Psalms xii. 6, lxvi. 10. On all these biblical references see Partington (1), pp. 487ff. A nice Chinese parallel for the sentence quoted from Proverbs comes to mind from the *Huang Chi Ching Shih Shu*¹ of +1060: 'Only after a hundred refinings does gold reach its essence and perfection; so also it is with men (*chin pai lien jan hou ching; jen i ju tshu*).'²

^l There are liturgical as well as biblical references. For example, the Ethiopian forms of the Liturgy of St Mark open with a prayer for the blessing and spiritual cleansing of the church, the congregation and the vessels, 'refining them seven times from all uncleanness and defilement, pollution and transgression, like silver refined, purged and tried from the earth' (Brightman (1), vol. 1, p. 195; Rodwell (1), p. 2).

^m Blanco-Freijeiro & Luzón (1); Partington, p. 451; Maréchal (3), p. 108.

ⁿ M. Schumacher, in *The Times*, 15 Oct. 1968.

¹ 皇極經世書

² 金百鍊然後精人亦如此

analytical evidence is equally clear for the treasures of Darius in Persia about -500.^a

The use of cupellation and cementation by the Hellenistic artisans of the +3rd-century papyri has already been noted (p. 18),^b but the background of these techniques was the Egyptian gold industry and its refineries, an account of which, including the harrowing conditions in the mines, was given by Agatharchides in the -2nd century (about -170), and reproduced by Diodorus Siculus.^c India can be brought into the picture from this time (the -1st century) onwards, if we allow the present text of the *Arthasāstra* as old a date as that, for both cupellation and cementation figure in it—at latest it would parallel the Graeco-Egyptian papyri and the Babylonian Talmud—and they occur in all the later writings such as the +7th-century *Rasaratnākara*.^d Beyond this time it would be otiose to go, but naturally the techniques were familiar to the Arabic metallurgical chemists, as may be seen in the book attributed to al-Majrīṭī and dating from the late +10th or early +11th century.^e For Latin Europe the refining and testing of the precious metals, transmitted in the practical manuals of the +8th and +9th centuries, was expounded with clarity in the book of Theophilus Presbyter (Roger of Helmarshausen) about +1125.^f By this time we are within close distance of the official assaying described in the discourse on the Exchequer, *Dialogus de Scaccario*,^g of Richard FitzNigel, Bishop of London and Treasurer of England, about +1180. The first regular public coinage assay, the 'Trial of the Pyx', started in +1248, and then come the descriptions in Latin Geber's *Summa Perfectionis*,^h amplified by all the later metallurgical writers.ⁱ It may seem that we have now said more than enough about cupellation and cementation, but to have said any less would have done inadequate justice to a point of capital importance—the antiquity and universality of the testing and assay methods for the precious metals (Fig. 1302).^j

^a Partington (1), p. 405. The cupellation of argentiferous lead was the standard production process at Mt Laurion in Attica from at least the -5th century onwards (Lucas (1), p. 282; Ardaillon (1); Maréchal (3), pp. 98, 106).

^b Cf. Pliny, *Nat. Hist.* xxxiii, xix, 60, xxv, 84, xxxi, 95, xxxiv, xxxi, 121, xxxv, lii, 183, cf. Blümner (1), vol. 4, p. 133. These mentions will date from just before +77, but there is a less clear description of cementation in Strabo (c. -30), iii, 2, 8.

^c iii, 11 ff., expounded in Blümner (1), vol. 4, pp. 126 ff. This includes cementation with salt.

^d Ray (1), 1st ed. vol. 1, pp. 230 ff., 234, vol. 2, p. 4; 2nd ed. pp. 52, 54, 130, 222 ff. This work includes much personal observation of the age-old methods used by the Indian goldsmiths for purifying and assay.

^e Holmyard (4) on the *Rutbat al-Hakim*.

^f *De Diversis Artibus*, ch. 23 on silver cupellation, chs 33, 34 on gold cementation, tr. Hawthorne & Smith (1), pp. 96, 108 ff.; Dodwell (1), pp. 74, 84 ff.

^g Ed. C. Johnson (1). At this time one Master Thomas Brown, who had served Roger II in Sicily, came home to England and was appointed to the Exchequer. Here was a possible direct link with Arabic chemical knowledge and practice. Cf. Vol. 3, p. 563.

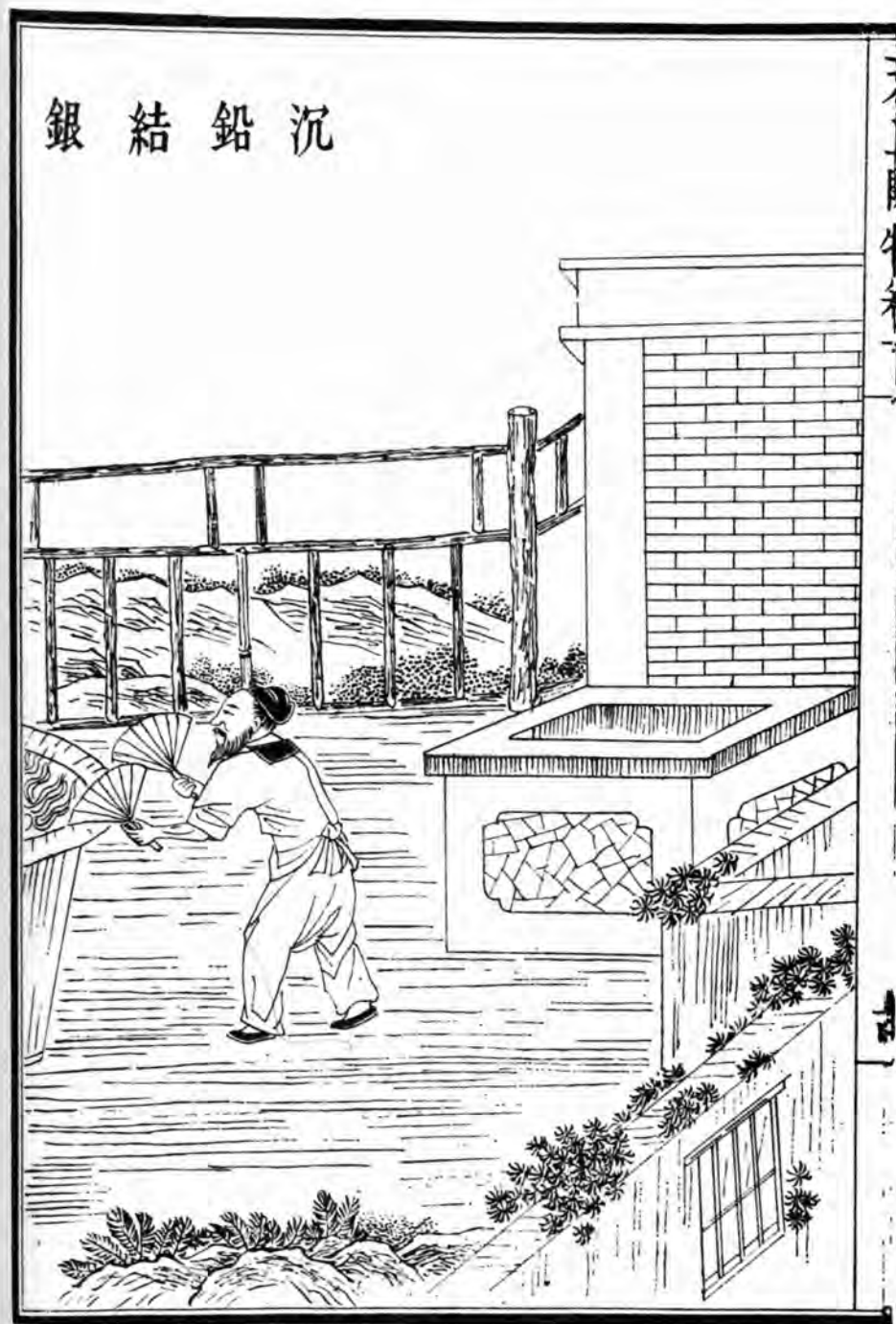
^h Chs. 88-91, Russell-Holmyard ed. pp. 180 ff., Darmstädter ed. pp. 87 ff.; Berthelot (1), p. 207. Cf. Leicester (1), p. 86; Wilson (3).

ⁱ For example, Lazarus Ercker (+1574), tr. Sisco & Smith (1); Biringuccio (+1540), tr. Smith & Gnudi (1). The earliest of the kind was the *Proberbüchlein* of about +1520, Anon. (88), tr. Sisco & Smith (2); cf. Wendtner (1). Arnold of Brussels (c. +1480) knew cupellation well, but he was more than half an alchemist (Wilson, 3).

^j The question of the knowledge and use of cupellation in the Amerindian cultures has been well discussed by Bergsøe (2). The artisans of the Esmeraldas coastal region of Ecuador, part of the late Inca empire, certainly had lead, but would only have 'cupelled' to remove copper from scrap gilt metal, since



Fig. 1302. Cupellation of argentiferous lead; from the *Thien Kung Khai Wu*



(+1637), a Chhing drawing. Ch. 14, pp. 14*b*, 15*a*, Sun & Sun tr., p. 241. See also Fig. 1303.

How then, in such a situation, could 'alchemy'—aurifaction—ever have arisen? The great pioneer, Berthelot,^a found this problem exceedingly puzzling, and bewilderment shows itself on every page of his general introductions. How could goldsmithery^b ever have turned into 'alchemy'? In one place, after remarking on the close parallelism of the papyri and the early texts of the Corpus, he wrote:^c

At the same time, the precision of some of the recipes common to the two sorts of documents, processes applicable still today and sometimes just like those of the Roret manuals,^d contrasting with the chimerical claim of aurifaction, evokes fresh astonishment in our minds. How can we comprehend the mental and intellectual state of men who practised these fraudulent techniques, intending to deceive others by the appearances of the products, and who yet ended by deceiving themselves, and believing that with the aid of some mysterious rite they could bring about a transformation of these gold- and silver-like alloys into real gold and silver?

It could only have been due, he thought, to the influence of magical and mystical religion. 'At one moment', he said, 'the maker confined himself to deceiving the public without self-delusion about his procedures (such was the character of the papyrus writer); at another he added magical formulae and prayers to his art, becoming thus the dupe of his own industry.'^e Another pioneer, von Lippmann, was also inclined to look at the matter in this way,^f but it will not do what we need because the whole environment of both the artisans and the philosophers was saturated by magic, gnosticism and theurgy.^g

Elsewhere, Berthelot tried another solution, more metallurgical in character. He wrote:^h

The operations (of the papyri artisans) were very similar to those of goldsmiths today, but now the State insists on the use of special markings so as to define the real titre of objects assayed in official laboratories, and it has carefully separated the trade in imitations and low-carat products from that in authentic precious metals. In spite of this the public is continually deceived because people are not familiar enough with the markings and means of control. . . .

their main source, native gold, did not need purifying from base metals. The fact that gold objects from Coclé have been found to contain traces of lead (Lothrop, 1) suggests therefore that the oxidative removal of copper with the lead oxide may have been known in pre-Columbian cultures. We place the word 'cupelled' in quotation-marks because the Ecuadorian Indians used no furnaces or crucibles, working entirely with the blowpipe on a charcoal bed, but the principle would have been the same. The Coclé finds further revealed many objects of gold-copper alloy free from silver, suggesting that the artisans there also practised salt cementation (as described by Gowland (7), p. 137 for Japan); and this impression is strengthened by a curious passage in Bernardino de Sahagun, quoted by Saville (2).

^a For a biography see Boutaric (1).

^b In his review of Hopkins (1), for whose ideas see pp. 21, 30 above, W. J. Wilson was justifiably critical, complaining that he made no mention of 'the perennial contest between the alchemist and the goldsmith'. In reading Hopkins one has always to remember his bizarre definitions; for him 'true alchemy' meant aurifaction including 'bronzing', and 'false alchemy' was aurifaction.

^c (2), p. 6, eng. auct.

^d Goldsmiths' practical manuals published in Paris by N. E. Roret from 1825 onwards. Cf. Rosenberg (1).

^e (2), p. 20, eng. auct.

(1), pp. 275 ff.

^g The associated papyri V and W are largely magical; cf. Berthelot (2), pp. 8 ff., 16 ff.; Griffith & Thompson (1). See the well-documented paper by Sheppard (1). On magic, spells and rites, Hopfner (1). On astrology Gundel & Gundel (1).

^h (2), pp. 53, 54, eng. auct.

In ancient times, the precise analytical means of today were not known... Hence it was only a step to the idea that it was possible to make the imitation so perfect that it would be identical with the reality. This was the step that the alchemists took.

Indeed, some may have thought that real gold and silver were themselves mixtures. 'The claim of doubling the amount of gold (or of silver) in associating it with another metal (*diplōsis*)... implies the idea that gold and silver were themselves alloys, and that it was possible to reproduce and multiply them by developing in the mixtures a metamorphosis analogous to fermentation and generation.'^a Berthelot also pointed out that transmutation was all the easier to imagine in those days because the pure metals with definite characteristics were not distinguished from their alloys, all carrying vague names such as *aes*, *electrum*, and the like.^b *Asem* was not only the natural alloy of gold and silver, but could be imitated by almost any bright metal made with copper, tin, lead, zinc, arsenic and mercury.^c Twelve or thirteen different alloys are called in the texts *asem*.^d

Nothing was more propitious for fraud than such a confusion, which must have been sedulously kept up by the operators. But by a feed-back easy to understand, it passed from the objects treated in the work into the minds of the operators themselves. The theories of the philosophical schools on 'prime matter', identical in every body but receiving its actual form from the basic qualities expressed as the four elements, encouraged and excited this confusion. Thus the workmen accustomed to compose gold- and silver-like alloys, sometimes so perfect that they themselves were deceived, ended by believing in the possibility of making these metals quite *de novo* by the aid of certain alloys and certain technical skills, completed by the help of supernatural powers, sovereign in any case over all transformations.^e

Here Berthelot touched a raw spot, the role of Greek philosophy, yet still felt compelled to suppose, as Hopkins put it, that 'the artisans for whom these recipes were written probably became real alchemists later'.^f This is what we might call 'the theory of the dupers duped'^g and it is really impossible to believe. Berthelot himself had the gravest doubts, for he could write:^h

The formulae (of the papyri artisans) are sometimes the same as those of the alchemical manuscripts. They were in fact instruments for the defrauding and illusion of the ignorant public. But how can the experts in the trade have thought so long that they could really succeed, by their artisanal techniques or by magic cantraps, in changing the appearance into the reality? We are confounded by the state of mind thus disclosed.

From +1697 onwards Isaac Newton was, as we saw, in a position of authority at the Mint in London, and there he himself carried out much experimental work, assaying many foreign silver coins, examining gold bullion, and testing the mechanical properties of various bronze compositions. But he did not rank this kind of work as part of chemistry or of any science, and we have his own words for it that 'refining and assaying are manual trades'. 'The assay-master', he wrote, 'acts only as a manual

^a (1), p. 240, eng. auct.

^c (2), pp. 62 ff.

^e *Loc. cit.*

^g (2), p. 61.

^b (2), pp. 54, 55.

^d (2), p. 73.

^f (1), p. 44.

^h (2), p. 64.

artificer.^a This disdain for the work of the artisan gives us, perhaps, the key to the whole problem. Everything that happened in the Hellenistic world about the origin of aurifaction, and not only there but in China earlier and India perhaps later as well, can be understood if we give up the *idée fixe* of the pioneer historians of chemistry that the artisans and the 'alchemists' were the same people. What is needed is a sociological approach something like that already adumbrated in several foregoing paragraphs, namely that there was a radical difference of social class between the artisan metal-workers and the dilettante philosophers.

On this view, the aurifactors and the aurifactors were two quite different social groups with comparatively little personal contact, though a certain restricted number of individuals must of course have known both intimately enough. The educated philosophical-mystical gentlemen found in the techniques of the practical artisans (which they went on to extend and develop in many original ways, as witness the inventions connected with distillation) a means of imitating and illustrating the cosmic processes on a 'laboratory scale', and hence the bringing of all metals to their perfection in gold, or rather in what the philosophers (virtuosi, we might almost call them) were prepared to define 'sophistically' as gold.^b The artisans, on the other hand, continuing their industry of precious metal substitutes, and having a definition of gold and silver, roughly speaking, similar to our own, remained capable of demonstrating that the philosophers had accomplished no real transmutations at all; but so long as the work of the adepts continued to be theoretical and didactic, not aiming at financial gain, and not impinging on the practical needs of princes and rulers, the artisans were very rarely called upon to do this.^c Some of the philosophers possibly did not know about the cupellation and cementation processes; others probably dismissed them as irrelevant on their definitions. They would have thought submission to the fire a spoiling of their subtle work. We know of nothing in the early history of proto-chemistry, aurifaction and alchemy which will not fall into place when this general interpretation is adopted.

Moreover, it is interesting to find that other historians of science have been led to adopt similar hypotheses in quite different fields. Ronchi has addressed himself to the question of why it took so long for the telescope to be developed by the simple combination of convergent and divergent lenses.^d Spectacle-lenses were developed towards the end of the +13th century by artisans, not by scientific philosophers, who even later for the most part ignored them, and Ronchi asked himself why no less than three centuries had to pass before people began to investigate the possibilities of combining the different sorts of such lenses together. And when this was at last done, it was done almost simultaneously and independently in the neighbourhood of +1600 by a number of men of more or less artisanal character, in Holland, Italy and England, perhaps

^a See Forbes (26); Craig (1, 2).

^b Sophist only meant a good arguer in ancient Greece, but it is remarkable that 'sophistication' came to mean in many European languages, as the centuries went by, the adulteration of goods and their falsification.

^c Cf. the revealing story of Mêng Shen in Vol. 5, pt. 3 below.

^d See (5, 6), and also (7) on the microscope. But see also Lindberg & Steneck (1).

also in China.^a The answer he found was that the scholars were highly conscious of the existence of what we call optical illusions, so that natural philosophy was blinded by the dictum: *Non potest fieri scientia per visum solum*—vision alone cannot be trusted.^b 'Fortunately for mankind,' said Ronchi, 'the artisans did not go to school and did not study philosophy.' It was Galileo who brought the two traditions together by abandoning the scepticism of the scholars and improving the telescope of the artisans.

(3) GOLD AND SILVER IN ANCIENT CHINA

And now it is time to take a third path from the belvedere and enquire more specifically into the situation in ancient and early medieval China. The usual unawareness of the explanatory power of sociological distinctions, such as could take into account the effects of class barriers in many societies of the past, was perhaps one reason for the failure of the most elaborate theory about the development of Chinese alchemy so far put forward, that advanced by Dubs in two learned memoirs (5, 34). Although the sinological scholarship which he applied to the problem was on a much higher level than that of any previous writers on the subject, except perhaps Waley (14, 24), his presentation was shot through with faults of reasoning, historical implausibilities, and misinterpretations of evidence both Greek and Chinese; indeed Dubs became so enamoured of his theory that the result, on careful consideration, seems one of the most remarkable instances of 'special pleading' yet encountered in these studies. Dubs the sinologist, 'as in private duty bound' perhaps, claimed for China the origin of all alchemy, a conclusion with which (on our definitions) we fully agree, but unfortunately he based it on the wrong reasons. His argument had two prongs: (1) that gold was particularly scarce in Shang and Chou China, (2) that cupellation was unknown there until late Chhien Han or Hou Han times, so that false could not be distinguished from true gold. 'Alchemy' (i.e. aurifaction), he said, 'could only have originated in a land where gold was not well known, and where methods were lacking for distinguishing it from imitations.'^c Again, 'alchemy [i.e. aurifaction] could not have arisen in Mesopotamia, for the people there possessed adequate means of assaying gold, which would eliminate alchemical productions'.^d Aurifaction cannot have started in Egypt for the same reasons.^e But to anyone who knows the literature of Hellenistic aurifaction and aurifaction it is instantly clear that this was precisely what did happen, i.e. that cupellation or no cupellation, aurifaction (*chrysopoia*) could rear its head in the midst of a culture some members of which knew very well how to unmask 'alchemical productions'—if the social situation ever called upon them to do so. The philosophical aurifactors, intent on quite different ideas of macrocosmic models, spiritual perfection mirrored in coloured golden metals or other substances (gold in their sense but not in

^a The facts have been put together by Needham & Lu Gwei-Djen (6) in connection with the contribution of Po Yü, c. +1630. Diverging lenses appeared much later than the converging ones, but in plenty of time for a scholarly invention to have been made if scholars had thought it safe to do so.

^b This was doubtless the reason why some scholars declined to look through Galileo's telescope, not so much the ingrained Aristotelianism to which the incident is usually attributed.

^c (5), p. 80.

^d (5), p. 84.

^e (34), p. 25.

ours), defined these productions in their own way, and saw to it that the artisans were not called in to upset their imagery. And what happened there, in Hellenised Egypt and other Mediterranean lands, could happen in China equally well, as in fact we think it did, probably at a slightly earlier date. What Dubs failed to appreciate was what the majority of historians of science also ignore, the existence of separate social cells within the successive levels of historical periods, always thought of as perfectly homogeneous.^a In order to put the two cases further on an equality we shall now attempt to show that metallic gold was not as scarce as all that in ancient China, and that cupellation was known and practised there from an early time.^b

Before doing this, however, we must point out the basic fallacy in Dubs' theory. He knew of course about the edict of -144 against the making of 'false yellow gold' by coiners (see Vol. 5, pt. 3 below), and of the elaborate failure of Liu Hsiang between -60 and -56, backed by all the resources of the Imperial Workshops, to make 'yellow gold' (see also pt. 3 below); in fact he himself had given the best account down to that time of both events earlier in the same paper. But he strangely did not see that by themselves alone they invalidated the idea that people in China did not know and practise cupellation, at least from the Chhin period onwards, otherwise how could they have distinguished false gold (*wei huang chin*¹) from true natural gold (*chen huang chin*,² *chen chin*,³ *shêng chin*⁴)? The touchstone was probably a far later introduction (+14th century),^c and density measurements *per se* would not have been very conclusive in those days, though this property of gold was certainly well known (such data are tabulated in the +3rd- or +4th-century *Sun Tzu Suan Ching*, Master Sun's Mathematical Manual).^d Illogically, Dubs adduced acceptable evidence for Babylonian astrological, metallurgical and chemical transmissions to China by the -6th and -4th centuries,^e but gave no reason why cupellation techniques should not have

^a They usually assume, moreover, that at any given time in history, everyone is aware of the ideas and doings of everybody else within whole cultural units. At various other places in these volumes we have emphasised the transmission of information from mind to mind across the most unlikely cultural and linguistic barriers, and the strange capillary channels through which it has flowed, but the converse also needs emphasis, the barriers of class as well as of foreign-ness. Sometimes indeed it might be easier for a man to pick up something important in a foreign city while oblivious of what was going on under his own nose in his home town.

^b Quiring (1), in what is probably the best general history of gold production, mining and metallurgy, unfortunately omitted China and India, probably feeling too unsure of the evidence and lacking orientalist assistance, though he dealt with West and Central Asia as well as Europe and Africa.

^c See Vol. 3, p. 672.

^d Vol. 3, p. 33.

^e The astrological transmission has been discussed already in Vol. 2, p. 353. Bronze, iron, mercury, the wheel, the chariot, must all have travelled eastwards during the -2nd and -1st millennia. It has even been suggested (Berriman, 2, 3) that the Han pound weight or catty (*chin*) was one quarter of the Babylonian *mina*, a standard weight of approximately 980 gms, now in the British Museum, which is self-dated to the reign of Nabuchodonassar II (-605 to -562) who modelled it on a previous Sumerian standard weight of Shulgi, king of Ur (III). One always suspects coincidence in comparative metrology, but the influence may perhaps be real.

We agree with Dubs on the principle of such transmissions if not on his details, but feel it necessary to emphasise that many of them went in both directions from the Fertile Crescent, west as well as east. One of the most outstanding examples of this would be the Pythagoras theorem (cf. Vol. 3, p. 96); and now Caratini (1) finds Babylonian circle geometry influencing both Hippocrates of Chios in Greece and the *Apastamba Sūtra* in India. Certain items of knowledge in physical acoustics (Vol. 4, pt. 1, pp. 176 ff.)

¹ 偽黃金

² 真黃金

³ 真金

⁴ 生金

been among them, though he was inclined to accept the cupel as the main factor in Liu Hsiang's — 1st-century fiasco.^a For him, the crucial time at which cupellation was unknown in China was the late Warring States period and Chhin, between Tsou Yen (cf. pp. 12–13) and Li Shao-Chün (cf. Vol. 5, pt. 3); hence macrobiotics could then join with aurifaction to produce a distinctively religious amalgam viable for centuries and transmissible to Islam and Europe. Our belief is that natural gold was very familiar in China at that time, and assay methods too, but that such circumstances did not prevent the rise of alchemy, the existence of artisans and their cupel furnaces being indifferent to the magian ideological impetus. What direct evidence there is for these early periods we shall see presently. But one more instance of Dubs' way of reasoning may be given. Under the Chhien Han it was customary for the lords and princes to present gold (*huang chin*¹) to the emperor each year on the occasion of the 8th-month sacrifices. The commentator Ju-Shun explained about +40 that the offering was rejected and the patrician punished if the gold was not up to weight, or if its colour was bad (*sé o*²).^b This cannot be taken to prove, as Dubs did, that colour was the only test in use; the words might be just a laconic description of debased metal alloys.

The extent to which Dubs minimised the gold industry in pre-Chhin China can perhaps be estimated by his complete silence about the existence of a gold coinage for centuries in one of the proto-feudal States. That there was such an industry for a thousand years before the time of Confucius^c is proved by the multitude of gold objects recovered from Shang and Chou tombs by modern archaeology.^d The money in question was that of the State of Chhu in the south, almost the only Chinese currency before modern times to have been stamped rather than cast;^e it consisted of small flat punch-marked square pieces of gold about 5 mm thick, apparently sometimes cut off from larger slabs bearing as many as twenty such stamps or seals, just as we detach postage-stamps from their sheets. This is called *yuan chin*,³ *yuan* being the unit marked by the stamp, each one of which carried also the name of the capital of Chhu, thus Ying yuan⁴ before about — 300, then Chhen yuan⁵ and Shou-chhun yuan⁶ successively before the absorption of the State into the unified Empire in — 223. The also illustrate this principle, and even more important, the lunar mansions in astronomy (Vol. 3, pp. 254ff.), and the pneumatic concept in physics, physiology and medicine (Vol. 4, pt. 1, p. 135, see also Vol. 6 *passim*). There seems to us no question that cupellation reached China from Babylonia, but we think the technique did its travelling about the — 7th rather than the — 1st century.

^a (34), p. 31, (5), p. 84.

^b CHS, ch. 6, p. 20a, tr. Dubs (2), vol. 2, pp. 80, 126.

^c Dubs (34) remarked that Confucius knew nothing about gold. Sivin (1), pp. 20ff., in his criticism parallel to ours, pointed out that Confucius never says anything about copper or its alloys either, though living in a culture where the finest bronze vessels were abundant. The Master did not talk about such mundane things (cf. Vol. 2, p. 14).

^d See Chêng Tê-Khun (9), vol. 2, pp. 7, 73, 161, 199, 245 for the Shang, vol. 3, pp. 12, 74, 77, 86, 89, 98ff., 104, 155ff., 236, 238, 245ff. for the Chou. Dubs' opinion was evidently based on museum curators' advice of the forties, now needing modification. He even went to the length of suggesting that a large gilt Shang axe described by Andersson (8) had been gilded in Han times and then buried or re-buried. Such a footnote needed shaving with Occam's Razor.

^e See Wang Yü-Chhüan (1), pp. 180ff.; Yang Lien-Shêng (3), p. 41; Chêng Tê-Khun (9), vol. 3, pp. 157, 262ff. Cf. Vol. 1, p. 247.

¹ 黃金

² 色惡

³ 爰金

⁴ 鄧爰

⁵ 陳爰

⁶ 壽春爰

date of introduction of this coinage is not known, but Ying city was founded about -700. Since however the oldest metal money, that of Lydia in Asia Minor, does not antedate the -7th century, it would be more reasonable to envisage the introduction of the *yuan chin* as having occurred in the -6th or -5th centuries, i.e. just about the time of Confucius. A point of much interest to us is that the first to find and study this gold money of Chhu was none other than our old friend Shen Kua, who described it in his *Mêng Chhi Pi Than* about +1086,^a and still more intriguing is the fact that he was inclined to accept the popular opinion that the pieces were 'alchemical gold' (*yao chin*) left behind by the Prince of Huai-Nan (cf. Vol. 5, pt. 3).

On the sources of gold in ancient China much remains to be done, but Dubs (4) devoted a special study to the gold reserves of the Hsin dynasty of Wang Mang, who by +23 had accumulated about 5,000,000 oz, more than the total supply of medieval Europe.^b Han Wu Ti two centuries earlier had been no indigent emperor, however, for by -123 he had given away in military rewards alone no less than 1,600,000 oz.^c Dubs was probably well justified in believing that a good deal of all this came from abroad, especially Siberia, by trade with the nomadic peoples, and after -110 from Europe over the Old Silk Road. The consensus of modern mining opinion seems to be that gold deposits are much more widely disseminated in China than has often been supposed, though in few places abundant.^d In Han times placer sites near the Poyang Lake in northern Chiangsu were prominent,^e but they seem to have been worked out already by the end of the period.^f Other sources are mentioned in the *Shui Ching Chu* (+3rd and +5th centuries).^g By the +10th century China was known abroad as a producer of gold.^h Extrapolating backwards from Han Wu Ti, it would seem very odd if Chhin Shih Huang Ti's gold reserves had not also been considerable.

The statement of Dubs that the early classics are silent concerning gold is very debatable. He argued that since all the other metals have their own special single characters, gold must have been the last of the metals to become known in China.ⁱ On

^a *MCPT*, ch. 21, p. 4b, 10, cf. Hu Tao-Ching (1), vol. 2, p. 680.

^b See also (2), vol. 3, app. 2, pp. 510ff.

^c *SC*, ch. 30, p. 4b, tr. Chavannes (1), vol. 3, p. 553.

^d See e.g. Bain (1), pp. 154ff.; Torgashev (1), pp. 121ff.; di Villa (1), p. 84; Mathieu (1), p. 463. There are many references in the bibliography of Wang Chung-Yu (1), pp. 17ff. Cf. too the old paper of Gutzlaff (1). In the early decades of the present century production in China ran to some 200,000 oz per annum.

^e *CHS*, ch. 28A, p. 38a; *Shui Ching Chu*, ch. 39, p. 14b.

^f *CHS*, ch. 28B, p. 38a, completed about +100.

^g E.g. the upper Han Valley near Chhêngku in southern Shensi (ch. 27, p. 9b), and in the Yangtze Valley in Hunan and Hupei east of the junction with the Hsiang R. (ch. 35, p. 3b).

^h E.g. in the *Kitāb al-Jauharatāin al-Atiqatāin wa'l-Hajaratāin al-mā'i'atāin al-ṣafrā' wa'l-baiḍā'* (Book of the Two Ancient Jewels and Fluid Stones, the Yellow and the White), by Abū Muḥammad al-Hamdānī ibn al-Ha'ik (d. +945, cf. Mieli (1), p. 115). This treatise, with its very Chinese-sounding title (cf. *huang pai shu*), contains good accounts of the winning of gold by amalgamation (cf. pp. 21, 242, 247 and Sect. 36) and of the cupellation of silver, mentioning also the exportation of gold from China; it has been partially translated by Dunlop (5) and fully by Toll (1). Al-Ha'ik is not to be confused with the other scholar of similar name, Rashīd al-Dīn al-Hamdānī (+1247 to +1318), of whom we had occasion to speak in Vol. 1, p. 218. On Arabic mint metallurgy see Toll (2); Levey (9).

ⁱ (5), p. 82.

grounds of evolutionary linguistics a more plausible case might be made out for its having been the first, all the others being distinguished by qualifying phonetic components. More important is the fact that the *Shuo Wên* lexicon, compiled by +121, gives the word *thang*¹ as an ancient and almost obsolete synonym for gold,^a adding that a second antique word, *lu*,² meant the 'best' gold.^b Refining must therefore have been practised in the Chou and Chhin periods from which the *Shuo Wên* scripts derive,^c and wherever there was refining, assay could not be far behind. The semantic significance of the simple radical must thus surely be 'the metal par excellence'. While it is true that, broadly speaking, *chin* can mean any metal, 'yellow metal' (*huang chin*³) is almost invariably gold,^d 'white metal' (*pai chin*⁴) almost invariably silver, and 'red metal' (*chhih chin*⁵) almost invariably copper;^e nevertheless some scope always remained for an ambiguity of which devious metallurgists could on occasion take advantage.^f In ancient texts *chin* has to be treated with caution, yet a careful look shows that there is no reason for denying it the meaning of gold in some cases.

^a Ch. 1A, (p. 13.2).

^b Ch. 14A, (p. 297.2); cf. *Erh Ya*, ch. 6, p. 6b, discussed on p. 54 below. *Lu* was soon replaced by simpler expressions such as *shu chin*⁶ for gold purified by cupellation. In earlier times it had had another meaning also in the expression *hsün lu*,⁷ which occurs in Chou bronze inscriptions of the Chhun Chhiu and Chan Kuo periods, and is taken to mean 'dark metal (bronze) of good quality' (private communication from Dr Cheng Tê-Khun).

^c The 'greater seal' style is supposed to derive from Shih Chou, c. -800, and the 'lesser seal' from Li Ssu in -213; cf. Bodde (1).

^d Cf. Dubs (2), vol. 1, pp. 111, 175.

^e Cf. the commentary in *CHS*, ch. 24B, p. 10a (Swann (1), p. 268). Later 'caerulean metal' (*chhing chin*⁸) was added for lead, and 'black metal' (*hei chin*⁹) for iron. This made up another of the symbolic correlations with the Five Elements and the directions of space. Gold would then obviously correspond with the yellow centre, lead with the caerulean east, copper with the red south, silver with the white west and iron with the black north. Cf. also Chang Hung-Chao (1), p. 310.

^f Cf. Chang Hung-Chao (1), pp. 320ff. Chang has two arguments to show that *huang chin*³ sometimes anciently meant copper or bronze, but neither is very cogent. The Shun Tien chapter of the *Shu Ching* (ch. 2, perhaps -7th century) says that fines were paid in 'metal' (Medhurst (1), p. 25, Karlgren (12), pp. 5, 6). Khung Ying-Ta,¹⁰ commenting on this about +600 in his *Shang Shu Chêng I*,¹¹ says that 'since the (*Shang Shu Ta*) *Chuan*¹² (of Fu Shêng,¹³ in the -2nd century) the tradition has been that yellow metal (*huang chin*,³ normally gold) was what they paid their fines in, but actually it was most probably *huang thieh*¹⁴ (gilded iron, or some yellow alloy containing iron)'. What Khung Ying-Ta had in mind is not at all clear, but iron did sometimes enter into auriferous processes, as the story of Wang Chieh (Vol. 5, pt. 3) shows. Moreover, the 'yellow iron' was an old term, for Fu Shêng also used it in his commentary on the Lü Hsing chapter of the *Shu Ching*, also in connection with fines. In any case, Chang concludes that *huang chin*³ was what we now call copper or bronze because obviously the people of those times would have paid their fines in those metals. This simply assumes that in those days gold and iron were not available, which may be true of iron but much less likely so of gold. Fu Shêng may have been wrong, but that is no proof that *huang chin*³ for him meant bronze.

Similarly, the *Shan Hai Ching* (almost undatable but in this context not later than the -4th century) says (ch. 5, pp. 37b, 38a, cf. de Rosny (1), p. 286) that the Yang side of a certain mountain has much 'red metal' (*chhih chin*¹⁵) while the Yin side abounds in whetstone (*chih shih*¹⁶), so also the Yang side of another mountain has much *huang chin*³ while again the Yin side abounds in whetstone. Chang urges that since the mountains were so near their geological formation must have been similar, so that *huang chin* = *chhih chin*, and both = copper. In view of the legendary character of so much of this text, the conclusion is unacceptable. That elsewhere in it *chhih chin*¹⁵ could sometimes mean haematite (*chê*¹⁷) rather than copper, may well be.

¹ 璽

⁶ 熟金

¹¹ 尚書正義

¹⁶ 砥石

² 鏐

⁷ 玄鏐

¹² 尚書大傳

¹⁷ 錯

³ 黃金

⁸ 青金

¹³ 伏勝

⁴ 白金

⁹ 黑金

¹⁴ 黃鐵

⁵ 赤金

¹⁰ 孔穎達

¹⁵ 赤金



Fig. 1303. Liquefaction furnace for the separation of silver from copper by lead, which is afterwards cupelled (cf. p. 60). *Thien Kung Khai Wu* (+1637), Ching drawing, ch. 14, pp. 15b, 16a; Sun & Sun tr., p. 242. On the process see Gowland (9), p. 296, (11); Hawthorne & Smith (1), p. 139 for Theophilus;

分金爐清鏽底

天工開物卷下

五



Smith & Gnudi (1), pp. 156ff. for Biringuccio; Hoover & Hoover (1), pp. 491ff. for Agricola; and Sisco & Smith (1), pp. 224ff. for Ercker.

The nearest mention in the *Shih Ching* (Book of Odes), c. – 8th century, is ‘metals of the South’ (*nan chin*),^a which commentators have taken to be the same as those referred to in the Yü Kung chapter of the *Shu Ching* (Historical Classic), where two of the southern provinces, Yang-chou and Ching-chou, send ‘the three grades of metal’ (*chin san phin*)^b to the Chou capital.^c This may have been compiled about – 470 but there is much to indicate that it refers to conditions in the neighbourhood of – 800,^c and the majority of commentators ever since have taken the three to be gold, silver and copper. In the *I Ching* (Book of Changes), the relevant part of which may be dated as earlier than the – 4th century, there is mention of ‘yellow gold’ (*huang chin*),^d perhaps the oldest instance of the binome.^d Competing with this are its occurrences in the *Kuan Tzu* book, where *chin* alone, moreover, is coupled in demonstrative contiguity with jade and pearls,^e the metal being produced, just as we would expect, along the rivers of Chhu. Finally, in the *Chou Li*, compiled in the Chhien Han but containing much material from – 4th-century Chhi, the Fang-hsiang-shih^f exorcist has four eyes of gold (*huang chin*)^g sewn on to his robes.^f It really cannot be said that there is no gold in the classics.

What has just been reported about the most ancient terms for crude and refined gold must now be amplified by a reference to the parallels for silver. The *Erh Ya* (Literary Expositor) dictionary, the text of which goes back to the – 3rd century, the Chhin time and the very beginning of the Han dynasty, speaks as follows:^g ‘The yellow metal (*huang chin*, gold) is called *thang*,^h and the best kind of it is named *lu*.ⁱ The white metal (*pai chin*, silver) is called *yin*,^j and the best kind of it is named *liao*.’^j On which Kuo Pho in the + 3rd century comments: ‘This refers to the fact that gold and silver have different names to designate their (crude and) purified forms (*tzhu chieh tao chin yin chih pieh ming chi ching ché*).’^k It would thus be hardly possible to deny that the men of late Chou, Chhin and early Han times were acquainted with the procedures of cupellation, and most probably also parting by cementation.^l

^a IV (2), iii, 8 in Legge (8), vol. 2, p. 620; Mao no. 299; Karlgren (14), p. 257.

^b Karlgren’s ‘bronze of three qualities’ (12), p. 15, we do not find acceptable.

^c See the discussion on the dating in Vol. 6, Sect. 38.

^d Kua no. 21, Shih-Ho¹¹, cf. Vol. 2, p. 316. Wilhelm-Baynes tr., vol. 1, p. 94; Legge (9), p. 102. It may not be entirely without significance for gold refining that the meaning of this *kua* is ‘biting and burning through’.

^e Ch. 77, pp. 2b, 3a, tr. Than Po-Fu et al. (1), p. 147. It is hard to distinguish what metal is referred to in each of the occurrences of *chin* in the *Tso Chuan*, but for some of them, such as presents of ceremonial belts, gold is much more appropriate than bronze.

^f Ch. 8, p. 6a (ch. 31), tr. Biot (1), vol. 2, p. 225.

^g Ch. 6, p. 6b, tr. auct.

^h Also defined, as we saw, in *Shuo Wen* (+ 121), ch. 1A, (p. 13.2). Presumably the jade and water radicals were used because alluvial gold particles looked like yellow jade powder sparkling among the sand grains in a ‘soupy’ sediment. Indeed, Hsü Shen says as much.

ⁱ See also *Shuo Wen*, ch. 14A, (p. 297.2).

^j *Shuo Wen*, ch. 14A, (p. 293.2).

^k He continues with a further comment which will more conveniently be considered on p. 261 below.

^l Such too is the opinion of Chinese historians of chemistry, e.g. Hsüeh Yü (1).

¹ 南金

² 金三品

³ 黃金

⁴ 方相氏

⁵ 璽

⁶ 鑄

⁷ 白金

⁸ 銀

⁹ 鑛

¹⁰ 此皆遺金銀之別名及精者

¹¹ 噉噉

(4) CUPELLATION AND CEMENTATION IN ANCIENT CHINA

What more can be said about the antiquity of cupellation in China? In Huan Khuan's¹ *Yen Thieh Lun*² (Discourses on Salt and Iron), written in the form of a verbatim transcript following the nationalisation conference of -81, we come across a proverb to the effect that 'When the molten gold (*shuo chin*³) is in the furnace, even Robber Chih (*tao Chih*⁴) will not want to steal it'.^a This is of course the famous character, type of all brigands, to whom a whole chapter is devoted in the *Chuang Tzu* book (c. -290).^b It is then not difficult to trace this saying back to its earliest occurrence, and that is in the *Han Fei Tzu* book, datable a little later (c. -280).^c There Han Fei's argument concerns the desirability (in the eyes of the Legalist School) of strict laws and severe punishments specified beforehand and firmly and instantly applied. The passage goes: 'Ordinary people will hold on to a piece of cloth 1 or 2 ells in length and not yield it (in taxation, because they can easily conceal it). But even Robber Chih himself would not touch gold, though a hundred *i*⁵ in weight (about 2000 oz), if it were molten.' Although the qualifying adjective 'yellow' is not present in these sentences, proverbs always have to be laconic, and there is significance in the fact that the *i* as a weight was traditionally that used for gold, something like our old troy system.^d If molten gold was in furnaces at the beginning of the -3rd century, cupellation was going on as well as casting, and where such precious stuff was concerned weighings can surely be assumed, so that this reference may be compared with the Palestinian ones mentioned on p. 40. Its position in Chinese history is important, for it comes just after the time of Tsou Yen, and about a century and a half before that of Li Shao-Chün. Moreover, the proverb was very well known, for we find it used in a number of later texts, notably a speech of Li Ssu's⁶ in -208 (still before Li Shao-Chün's time) where the emphasis is laid upon the immediate retribution which Robber Chih would suffer if he made off with metal in a state of fusion.^e Much later on, in the Liang period, the saying appears again, in the *Hsin Lun*⁷ (New Discourses) by Liu Hsieh,⁸ the famous literary critic (d. +550). 'When molten gold is in the furnace, robbers will not dare to touch it. It is not that they do not desire it, but touching it will burn their hands.'^f For the rest we need only remark that the coining edict of -144 (p. 12) was concerned with practices which must have started not long after Li Ssu's speech, if they were not already going on in the Chhin, and that the failure of Liu Hsiang to make artificial gold in -56 was only a few decades after the writing of Huan Khuan.

The next passage is in the *Chou Li* (Record of the Institutions of the Chou Dynasty), put together not in the Chou but in the Chhien Han, and therefore mostly of the

^a Ch. 58, p. 12a, cf. *Yen Thieh Lun Chiao Chu*, ch. 10 (p. 362).

^b Ch. 29, cf. Vol. 2, p. 101.

^c Ch. 49, p. 2b, tr. auct. adjuv. Liao Wên-Kuei (1), vol. 2, p. 283.

^d Besides, the repeated references to robbers would not be so appropriate for copper, tin or bronze.

^e *Shih Chi*, ch. 87, p. 16a, cf. Bodde (1), p. 40. He was quoting *Han Fei Tzu*.

^f Ch. 47, tr. auct.

¹ 桓寬

² 鹽鐵論

³ 鑠金

⁴ 盜跖

⁵ 鎰

⁶ 李斯

⁷ 新論

⁸ 劉勰

—2nd or —1st centuries. It is very unfortunate that the goldsmiths' section was lost early from the *Khao Kung Chi* section of this work, for it would have given valuable evidence for procedures in —4th-century Chhi and served perhaps as a Chinese parallel for the Hellenistic papyri. However, the entry for the Chih Chin¹ (Superintendent of Metals and Minerals) is relevant to our problem.^a

The Chih Chin is concerned with the laws relating to gold, jade, tin,^b (precious and ornamental) stones, and red and caerulean pigments. He receives the consignments which come in from taxation, and distinguishes the quality of the materials, whether refined or crude (*mei o²*),^c as well as recording their quantities and weights. Then he marks them with the imperial seal. He deposits the gold and the tin in the Armoury (*ping chhi chih fu³*), and the jade, stones and pigments in the Treasury (*shou tshang chih fu⁴*), handing in a copy of his register. He is also charged with receiving fines paid in metals and money, and these he delivers to the Arsenal Administrator (Ssu Ping⁵). When there is a Lü sacrifice to Shang Ti, he presents plates of gold, as also when a banquet is offered to the feudal lords and princes. Whenever there is great cause for alarm in the country, and works in metal and stone have to be undertaken, he has to direct them.

The interpretation here is a little difficult. Chin⁶ in the first sentence can hardly be '(the five) metals' because tin follows, and copper would therefore make better sense, especially since both are deposited (fourth sentence) in the armoury or arsenal (iron weapons are not taken account of in this archaic, or archaizing, text). But the fact that in the first sentence *chin⁶* precedes jade indicates that we should take it as gold,^d and perhaps *hsi⁷* as bronze; their deposit in the armoury need not contradict this if wealth is the 'sinews of war'. Furthermore the purity of copper and tin (second sentence) was never nearly so important a matter as that of gold and silver. The fines of the fifth sentence might be either in bronze or gold,^e but more probably the former in view of where they go to. On the other hand in the last sentence but one the *chin pan⁸* can hardly have been anything else than plates of gold.^f On the whole therefore this passage can be taken as furnishing evidence for the refining and hence the assay of gold about —150, just in the period of the anti-coining edict. It may well imply, as the *Khao Kung Chi* itself would do, the early —4th century.

By the time that we reach the date of the *Shuo Wên*,⁹ about +120, the statements become much more explicit. In his entry for gold Hsü Shen¹⁰ says:^g

Of the five coloured metals, the yellow is the most (valued). Left for a long time in damp places it never corrodes, and refined a hundred times it never loses any weight (*pai lien pu chhing¹¹*).

^a Ch. 9, p. 29a (ch. 36), tr. auct., adjuv. Biot (1), vol. 2, p. 361.

^b Or bronze.

^c These words could also be translated 'fine or poor', as applied to natural products. Here both senses would have been implied.

^d Biot, following the commentators, did so, but showed his uneasiness by adding the word 'metal' between gold and tin in the fourth sentence.

^e Some commentators say that people paid in coin if they had no gold.

^f So the commentators take it.

^g Ch. 14A, p. 293.2, tr. auct.

¹ 職金

² 嚴惡

³ 兵器之府

⁴ 守藏之府

⁵ 司兵

⁶ 金

⁷ 錫

⁸ 金版

⁹ 說文

¹⁰ 許慎

¹¹ 百鍊不輕

There is a similar statement in the *Tshan Thung Chhi*¹ of Wei Po-Yang,² for which we accept the date of +142 (cf. Vol. 5, pt. 3 below).^a

When gold is placed in a hot fire it is not deprived of the brilliancy of its colour. Since the day of the unfolding of the universe the sun and moon have never faded, and gold has never lost any of its weight (in the furnace).

There is here also another passage which may refer to the cupellation of gold, though it is so ambiguous and allusive that it is not possible to be sure.^b Translating it on this assumption, it would read something like this:

Gold must be like a dyke or embankment with liquid (lit. water) flowing freely around it. The reckoning of gold is as 15, so also is that of the liquid (lead in the cupel). The weight in ounces and twenty-fourths of an ounce (*shu*³) must be known before the gold enters the furnace. There should be an excess of five parts of the molten liquid, and these are the two substances realised. The weight of the gold will remain the same as at the beginning (if it is pure). The earth^c (cupel ash) will not enter it, but the other two (lead and fire) will do so. The three things will mutually embrace each other and marvellous changes will be seen.^d Below is the *chhi* of Thai-Yang (i.e. the fire), and (as the heating goes on) there will suddenly be a volatilisation and liquefaction followed by solidification; this is the formation of the 'Yellow Carriage' (*huang yü*⁴). But as the time draws to a close the nature of the metal may be destroyed and its life shortened.^e (Eventually) the character and material (of the liquid) turns to a powdery ash like 'bright window dust' (motes in a sunbeam)...^f

Here we begin with the weighing of the precious metal (if *chin*⁵ is so to be interpreted) and end with the litharge mixed with the ash of the cupel.

Probably the best early texts about cupellation and cementation are contained in a work entitled *Huang Ti Chiu Ting Shen Tan Ching Chüeh*⁶ (Explanation of the Yellow Emperor's Canon of the Nine-Vessel Spiritual Elixir),^g a work mainly of the early Tang or early Sung as we have it now, but containing some material (ch. 1) probably as old as the +2nd century because Ko Hung quotes it. The following passages cannot therefore be exactly dated, but it would not be fanciful to think of them as in the same category as the Hellenistic papyri of the +3rd century, though

^a Ch. 10, p. 216, tr. auct., adjuv. Wu Lu-Chhiang & Davis (1), p. 240.

^b Ch. 14, p. 306, tr. auct., adjuv. Wu Lu-Chhiang & Davis (1), p. 243; Liu Tshun-Jen (1), p. 87. Elsewhere (Vol. 5, pt. 3 below) we give the alternative interpretation of it as a description of elixir-making involving gold-mercury or lead-mercury amalgamation, but if the 'liquid' mentioned is meant for molten lead rather than mercury then cupellation is intended. Of course late *nei tan* commentators such as Lu Hsi-Hsing in the +16th century interpreted the whole as an allegory of sexual and physiological procedures, and as we explain in the appropriate place (Vol. 5, pt. 5) all these significances may have been present simultaneously.

^c Reading *thu*⁷ for *san*.⁸

^d May this not refer to the moving surface films of lead and other base metal oxides?

^e Perhaps vaporisation caused by excessive heat.

^f A phrase often subsequently recurring, cf. pt. 3.

^g TT878. There is an abridgment in YCCC, ch. 67, pp. 1 aff., but it does not contain the passages in question.

¹ 參同契

² 魏伯陽

³ 銖

⁴ 黃輿

⁵ 金

⁶ 黃帝九鼎神丹經訣

⁷ 土

⁸ 三

they might well be +4th or +5th. First come two procedures for the cementation of gold to remove silver and all other admixed metals as the chlorides.

It is absolutely inadmissible not to differentiate between the quality of samples of gold, whether fine or base.

If silver is alloyed (with copper) the colour of the mixture will be caerulean-yellow.^a If gold is alloyed (with copper) the colour will be purplish-red. When they are roasted they give off black vapours, and neither is suitable for use (in making elixirs). But the colour of fine gold is yellowish-red, and a hundred refinings will not diminish its weight (*pai lien pu hao*¹).

Although one may have obtained some gold (it may not be very pure). So one should beat it into thin plates, as is often done among the common people,^b and then bake it with salt (in a furnace) for a day and a night. Remove it (from the crucible), melt it (again), beat it, and bake it again (with salt). Continue the operation until there is no loss of weight, then stop.^c

A page or two later we read:

Method of refining crude gold taken from streams (placer gold). Use clean earthy clay (*kan thu*²) to make a crucible, and dry it by baking over fire. Use pinewood charcoal and place the crucible in the furnace, then put the crude gold inside it. Work the furnace bellows to blow up the fire, and when the metal has melted put powdered salt in with it, stirring well. Watch until full fusion has taken place and then use a thornwood stick to remove the slag (*o wu*³). Continue to add powdered salt, and go on stirring and removing slag. When the process is complete pour the metal out into a mould making sure that no cracks or fissures appear. If they do, then mix equal amounts of iron filings ground to powder, ash of burnt cow-dung, and powdered salt, warming them over a cow-dung fire until the mixture becomes uniformly granular; then add it to the re-heated gold. (After some time) take a look, and if it has become soft, remove it and beat it into thin sheets. Mix equal amounts of yellow alum and poplar-balsam^d and liquefy them (by heating) with mud; then smear the mixture over the gold leaves and heat them over a charcoal fire. Stop when red heat is reached. Repeat the process four or five times, and you will get the best quality of red gold.^e

Here the addition of iron and sulphate, just as in the ancient Western procedures, is noteworthy. Further on in the same chapter there occurs the following:^f

Method of smelting silver from the ore.

If the silver one has is of good quality and white, then take white alum and powdered sal ammoniac and roast it with them in the fire. If it is not good and white then it is still crude, so one should mix one pound of it with one pound of ripened lead (and heat it in a crucible made of) purified ashes; then it becomes high-quality white silver.

How to make the cupel (*phei*⁴) that stands within the muffle (*huo wu*⁵). Earth is packed together to form a trough (*tshao*⁶) 3 ft deep and any convenient length; within this place the moulds (*mo*⁷) must be, in each of which a cupel is to be made. Take finely sifted and purified

^a Cf. Hiscox (1), p. 69.

^b This phrase may refer to the cementation with salt rather than to the beating of gold leaf, though on archaeological evidence that is old in China. There is a lot about it in *TKKW*, cf. Sun & Sun tr., p. 237.

^c Ch. 9, p. 1a, tr. auct.

^d *Hu-thung-lü*⁸ for *hu-thung-lei*⁹; from *Populus balsamifera*, cf. Laufer (1), p. 339.

^e Ch. 9, pp. 2b, 3a, tr. auct. Cf. Fig. 1304.

^f Ch. 9, p. 7a, b, tr. auct.

¹ 百鍊不耗

² 甘土

³ 惡物

⁴ 坯

⁵ 火屋

⁶ 槽

⁷ 模

⁸ 胡同律

⁹ 胡同淚



Fig. 1304. Metallurgical sage superintending a cupellation, from the *Shih Lin Kuang Chi*; or perhaps a gold cementation using salt, or ammonium chloride and saltpetre. *Chi shu lei* sect., p. 7b. Edition of +1478, the work having been first printed in +1325, and compiled between +1100 and +1250.

ashes and fill up the moulds, adding some water so that the stuff is neither wet nor dry, and so use it. Press it down lightly so that it becomes firm, then take a knife and scrape it out so as to make it into a cup-like (*phei*¹) or crucible shape. Spread a thin layer of salt over the cupels, and put in the crude silver (with some lead). Cover up with yellow earth, and pack all round and above with charcoal; when this is done make a roof for the furnace of sun-dried tiles, arranging a hole directly above each cupel to allow the escape of the copious vapours. Then in front of each cupel all round there must be an opening. When the time comes the contents should be regularly observed. (Towards the end of the heating) take an iron hook and remove viscous slag (*thang shih*²). After some time the fire penetrates all through, and the lead and silver begin to boil, swirling round in violent motion; eventually the lead disappears (lit. separates) and the silver moves no more.^a Beautiful colours of purple, green and white are then to be seen.^b A damp cloth on the end of a stick may now be used to cool down the silver. This is when it is called 'dragon-head' (*lung thou*³) (silver).^c Then take an iron spoon and remove (the lump). Hence the expression 'dragon-head white silver method'.

This text is accompanied by a small diagram, reproduced herewith (Fig. 1305) though somewhat obscure in character. Thus in this book we have rather complete descriptions both of the cupellation of silver and the cementation of gold.

There are many further accounts of these processes in the later literature^d but it is unnecessary to reproduce them here since there is no dispute that they were well known by the beginning of the Thang. In his *Pên Tshao Thu Ching*⁴ of +1061 Su Sung⁵ says in his entry for silver that 'when silver is in its ore, it is (often) mixed with copper, so the local people who collect this have to add lead and heat repeatedly before they obtain the precious metal. This is then called "refined silver" (*shu yin*⁶).^e But in the pharmaceutical natural history treatises the cupellation processes are often found described under the head of litharge (*mi-tho-sêng*,⁷ from Pers. *mirdāsang* or *murdāsang*),^f for this was recovered from the cupel ash, and by Su Sung's time no longer imported from Persia,^g as it had been in +659 when Su Ching⁸ compiled and annotated the *Hsin Hsiu Pên Tshao*,⁹ oldest of the official pharmacopoeias.^h We shall give Su Sung's account in Sect. 34 on chemical technology, as also what the *Thien Kung Khai Wu*

^a This is the phenomenon of 'brightening'.

^b Probably iridescent colours on the surface of the molten metal. But if the furnace was very hot, the green colour of silver vapour might possibly have been observed.

^c Presumably a reference to the button or lump of purified metal.

^d E.g. *TT*907, ch. 2, p. 2b (+1220).

^e Cit. *PTKM*, ch. 8, (p. 5), tr. auct. Fig. 1303 shows the liquation furnace.

^f See Laufer (1), p. 508, and the comments of Chang Hung-Chao (8), pp. 40-1.

^g Su Sung's words are found in *CLPT* (+1249), ch. 4, (p. 113.2) and *PTKM*, ch. 8, (p. 20).

^h Ch. 4, p. 12b, where he says that it was a Hu, or Persian, word. It is not mentioned in the *Shen Nung Pên Tshao Ching* of the Chhien Han period, nor in *Pao Phu Tzu*, so the trade must have started some time in the Liu Chhao. See RP 14. Fair enough, but this is one of those cases where a fundamentally foreign origin cannot be deduced from proving the foreign-ness of a name, as Laufer always assumed. The Chinese may well have thought of litharge in early times only as a by-product of cupellation, and used some name for it that did not get into the scholarly books (very likely *lu ti*,¹⁰ *chhien chiao*¹¹ or *huang tan*¹²). A foreign name can prove a foreign trade but not the first knowledge of a thing.

¹ 坯

² 糖屎

³ 龍頭

⁴ 本草圖經

⁵ 蘇頌

⁶ 熟銀

⁷ 密陀僧

⁸ 蘇敬

⁹ 新修本草

¹⁰ 爐底

¹¹ 鉛脚

¹² 黃丹

訣經丹神鼎九帝黃

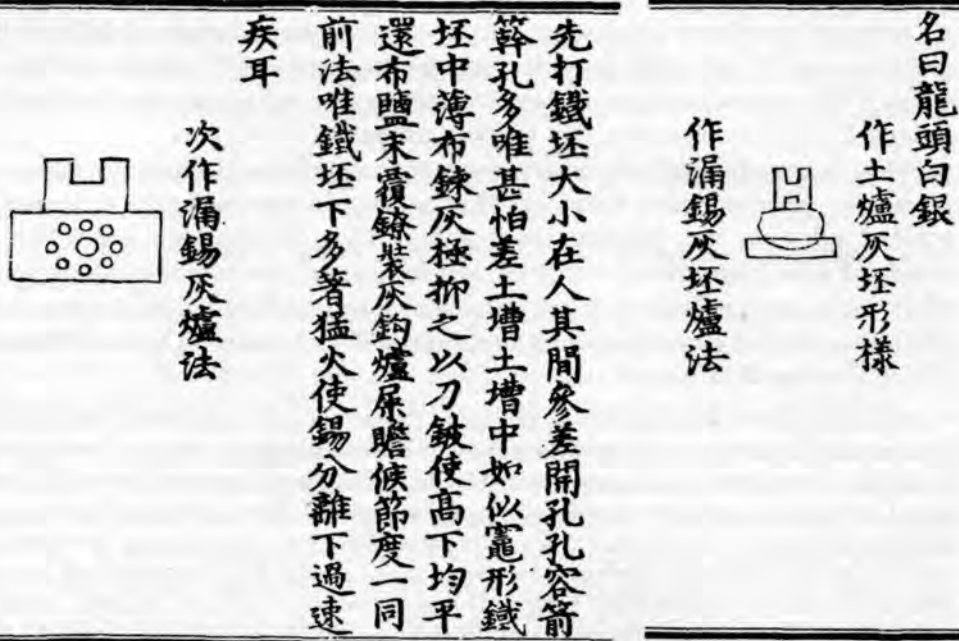


Fig. 1305. Diagrammatic sketches of cupellation furnaces from *Huang Ti Chiu Ting Shen Tan Ching Chüeh* (TT 878), ch. 9, pp. 7b, 8a.

(+1637) has to say on cupellation processes. There is a rather better description somewhat earlier, in the *Shu Yuan Tsa Chi*¹ (Bean Garden Miscellany), written by Lu Jung² in +1475, but as it is intimately connected with silver mining we shall postpone it until Sect. 36 on non-ferrous metallurgy.^a

Lastly, one must not forget the relevant section of the *Shih Lin Kuang Chi*³ encyclopaedia (Guide through the Forest of Affairs), compiled by Chhen Yuan-Ching⁴ some time between +1100 and +1250, and first printed in +1325. To illustrate the present discussion we reproduce its picture of a metallurgical sage giving instructions on cupellation procedures (Fig. 1304) from the rare edition of +1478.^b Among other things this section contains some excellent descriptions of cementation processes for the surface enrichment of gold alloys, using sodium or ammonium chlorides and various kinds of alum to remove the other metals from the superficial layers.^c These correspond in close detail with instructions given in practical treatises of the present day.^d There

^a There are many accounts of the traditional methods of cupellation persisting in China and Japan by modern observers; see e.g. Wu Yang-Tsang (1); Clark (1); Gowland (6); Geerts (4, 6). More may be said of these in Section 36. Cf. Figs. 1302, 1303.

^b In the Cambridge University Library. *Chi shu lei* (*Huan shu*) section.

^c So also *Ko Ku Yao Lun* (+1388), p. 36a, tr. David (3), p. 135.

^d See e.g. Hiscox (1), p. 383.

¹ 菽園雜記

² 陸容

³ 事林廣記

⁴ 陳元觀

are also methods for gilding and plating, the whitening of brass with arsenic to look like silver, the yellowing of silver with arsenical sulphides to look like gold, the making of 'paktong' (*pai tung*,¹ the famous Chinese alloy of zinc and cupro-nickel),² and the preparation of 'mosaic gold' (stannic sulphide) long used in gold paints, and earlier in elixirs.³ The section is concise, and deserves close study and translation. So much then for cupellation and cementation in Chinese antiquity.

Before leaving this subject, however, a word might be said about the impression among the pharmaceutical naturalists that crude gold was poisonous to man while purified gold was not. Writing about +500, Thao Hung-Ching said:⁴ 'Natural unrefined gold (*shêng chin*²) wards off evil influences, but it also contains poison, which if the metal is ingested in the unpurified state (*pu lien*³) can kill.' Again, in his *Pên Tshao Shih I* of +725 (Omissions from Previous Pharmaceutical Natural Histories), Chhen Tshang-Chhi wrote:⁴

All gold is (more or less) poisonous, and natural unrefined gold (*shêng chin*²) very much so; if given as medicine it causes death. It is produced by the tribespeople south of the mountains (Ling-nan I-lao⁴) from caves (and streams) in the hills. The gold comes like red and black gravel, of the same category as (broken-up) ferric nodules. The southerners say that gold develops in places where the teeth of venomous reptiles have dropped out, or where they rested or where their toxic excrement lay about on the stones; and its poison is of the same category as that of orpiment and realgar. If a man has been poisoned by gold, he can be cured by applying snake preparations; see the entry for the Golden Snake.⁵ The *Pên Ching*⁶ says that yellow gold has poison, but this is quite wrong, for the natural gold and the yellow (refined and purified) gold are entirely different things.

This poisoning by the crude product might have been either physical or chemical, the former due to irritation by quartz crystals in the powder, the latter due to contamination with lead ores or pyritic sulphides, or most probably by arsenical ores. It may well be significant that Chhen says the poisoning is like that caused by arsenic.

(5) AURIFACTION IN THE *PAO PHU TZU* BOOK

In all this we have been lingering, as it were, in the workshops of the Graeco-Egyptian artisans, so we need now to examine something more closely corresponding to the Hellenistic mystical philosophers. The counterpoint of our theme thus leads us back from the papyri to the Corpus. With this in mind, probably the best thing to do is to see what the greatest of all Chinese alchemical writers, Ko Hung, said about the gold (or 'gold') which he averred could be made. Conclusions drawn from an attentive study of the *Pao Phu Tzu* book, c. +320, could be taken as fairly representative of all early

^a RP 6, cf. Hiscox (1), pp. 69 ff. under German silver or argentan. Also pp. 225 ff. below.

^b Cf. pp. 69, 271-2 and Vol. 5, pt. 3.

^c Cit. *CLPT*, ch. 4, (p. 109.1), tr. auct.

^d Cit. *CLPT*, ch. 3, (p. 97.2), tr. auct. Translations of further passages are given by Schafer (13), p. 251.

^e This *chin shê*⁵ is quite a well-known reptile, *Coronella bella* (R 116). It is native to Kweichow and Kuangsi. Its metallic golden or silvery scales brought about its selection in early times as an antidote.

^f The *Shen Nung Pên Tshao Ching*, earliest extant pharmacopoeia, datable in origin to the -2nd century.

¹ 白銅

² 生金

³ 不鍊

⁴ 嶺南夷獠

⁵ 金蛇

Chinese alchemy, and valid for most of its main tradition. We shall want, therefore, to ask a number of questions, and might phrase them somewhat as follows. How did Ko Hung think of transformation? What terms did he use for it? Did he know about cupellation? Did he consider his artificial golds different from natural gold, and if so did he think they were superior or inferior? And finally did he give specific names to them?

For Ko Hung, chemical change was only one aspect of those changes and transformations of which all Nature was full.

What is it [he said] that the arts of transformation (*pien hua chih shu*¹) (in Nature) do not accomplish?...

Animals in the class (*shu*²) of flying and running things, animals of the creeping and crawling category (*lei*³), have all been endowed in the creation (*tsao hua*⁴)^a with specific forms, but one could never finish describing the thousands upon thousands of metamorphoses (*is*⁵) which they suddenly undergo, changing their old bodies (for new), and turning into different things...^b

Even human beings have been known to change into animals or turned to stone or trees.^c Men may turn into women and vice versa.^d High mountains have become deep abysses, and gorges have been lifted to mountain heights.^e Lead is naturally whitish but it can be reddened and made to look like cinnabar,^f cinnabar is naturally red but it can be whitened and made to look like lead.^g Of metamorphoses among plants and animals there is no end—snakes turn into dragons,^h caterpillars into moths and butterflies, oysters into frogs, fieldmice into quails, alligators into tigers, rotting grass into fireflies,ⁱ monkeys turn into different species of monkeys as they age, and old bears become foxes,^j pheasants metamorphose to mussels and sparrows to clams.^k And 'they become exactly like the natural ones'.^l Ko Hung concludes:^m

It is clear therefore that transformation is something spontaneous (*tsu jan*⁶) in Nature. Why then should we demur to the possibility of making gold and silver from other things? Look at the fire obtained (from heaven) with the burning-mirror, and the water got at night from the moon-mirror; are they any different from ordinary fire and water?ⁿ

^a We warned the reader long ago (Vol. 2, p. 581, Vol. 3, p. 599) that this phrase must never be taken to imply Western ideas of creation *ex nihilo*. 'Endowed by the Shaping Forces' would perhaps be more appropriate.

^b *PPT/NP*, ch. 16, p. 2a, tr. auct., adjuv. Ware (5), p. 263.

^c *Ibid.* repeated in other words in ch. 2, p. 3a (Ware (5), p. 37).

^d *Nan nü i hsing*⁷ (ch. 2, p. 3a). Spontaneous sex reversals were well known in the Han already; see Needham & Lu Gwei-Djen (3), p. 165, and more fully in Sect. 45 in Vol. 6.

^e See Vol. 3, pp. 599 ff. 'Plutonic' and 'Neptunian' processes were both envisaged in early medieval Chinese geology, and there was a special technical term, *sang thien*,⁸ the 'mulberry grove', for land, even at the tops of mountains, which had once been covered by the sea, or valleys raised to become hilly places.

^f By the formation of the oxide, red lead. Pliny in fact confused the two substances.

^g By the preparation of mercury from it. Ch. 16, p. 2a (Ware (5), p. 263).

^h Ch. 16, p. 2b, Ware tr. p. 263.

ⁱ Ch. 2, p. 3a, Ware tr. p. 37. On the fireflies see Vol. 4, pt. 1, p. 75.

^j Ch. 3, p. 2b, Ware tr. p. 56.

^k Ch. 16, p. 5b, Ware tr. p. 268.

^l *Ibid.*

^m Ch. 16, p. 2a, tr. auct., adjuv. Ware (5), p. 263.

ⁿ We have dealt already with the burning-mirror and the dew-collecting mirror in Vol. 4, pt. 1, pp. 87 ff.

¹ 變化之術

² 屬

³ 類

⁴ 造化

⁵ 易

⁶ 自然

⁷ 男女易形

⁸ 桑田

Thus his view of Nature was a perfectly valid one, based upon much correct observation, though also on a fund of beliefs which had not yet been tested.^a We shall be the less inclined to condemn Ko Hung's dependence on metamorphosis stories if we remember that Petrus Bonus of Ferrara, one of the more estimable of the Western alchemists, was still using very similar arguments in his *Pretiosa Margarita Novella* written about +1330, a millennium later.^b

Nature generates frogs in the clouds, or by means of putrefaction in dust moistened with rain, by the ultimate disposition of kindred substances... The decomposition of a basilisk generates scorpions. In the dead body of a calf are generated bees, wasps in the carcass of an ass, beetles in the flesh of a horse, and locusts in that of a mule...

And he might well have added the metamorphosis of barnacles into geese, which was one of the most universal tenets of early Western natural history.^c To sum it up, Ko Hung's world-outlook was very similar to that described in the passage from Smith (4) quoted on p. 25 above.

He illustrates in another way, very instructively for our thinking on alloys and single metals, by a passage about glass.^d

In foreign countries [he says] people make bowls of glass (lit. rock crystal, *shui ching*¹) by combining five sorts of ash. Nowadays in our southern coastal provinces, Chiao-chow and Kuangchow, many have obtained knowledge of this art, and engage in such a smelting to produce it (*chu tso chih*²). But when they speak of it (as rock crystal) ordinary people will not believe them, saying that rock crystal is a substance found only in Nature (*pén tzu-jan chih wu*³) belonging to the category of jade. Therefore since natural gold (*tzu-jan chih chin*⁴) is a well-known and prized possession in society, why should ordinary people believe that there is any principle (*li*⁵) by which it can be made? The ignorant do not believe that minium (the red oxide) and white lead (the carbonate)^e are products of the transformation of lead, and many do not know that a mule is the offspring of a donkey and a mare, for they insist that everything has its own individual seed (*wu ko tzu yu chung*⁶). What then must it be with things really difficult to understand? He who has seen little, marvels much—that is the way of the world. As for belief, there are things that are as clear as the sky, yet men prefer to sit underneath an upturned barrel; that's the truest word ever said.

^a We shall of course discuss metamorphosis ideas fully in Sects. 38 and 39 on botany and zoology. It may be worth mentioning here, however, that they seem to have multiplied in the Warring States period, perhaps in association with the proto-scientific thinking of the School of Naturalists. They had a significance not only for chemical change but also for estimates of the possibility of human beings changing into immortals, and growing wings and feathers in the process (cf. pp. 96, 100 below). About -513 Chao Yang⁷ (Chao Chien-Tzu⁸) expressed envy of the metamorphoses of plants and animals, and regretted that man could not achieve some bodily transformation (*Kuo Yü*, ch. 15, p. 9a, *Chin Yü*, ch. 9). But from the -4th century onwards 'feathered men', i.e. immortals (*yü min*,⁹ *yü jen*¹⁰) are often referred to (as in *Shan Hai Ching*, *Lü shih Chhun Chhiu*, *Huai Nan Tzu*, etc.), and frequently depicted in Han art.

^b See Holmyard (1), pp. 140, 141.

^c See Heron-Allen (1).

^d Ch. 2, p. 11a, b, tr. auct., adjuv. Ware (5), p. 52. On the history of glass-making and the glass industry in China see Vol. 4, pt. 1, pp. 101 ff.

^e On this important substance see Vol. 5, pt. 3 below.

¹ 水精

² 鑄作之

³ 本自然之物

⁴ 自然之金

⁵ 理

⁶ 物各自有種

⁷ 趙鞅

⁸ 趙簡子

⁹ 羽民

¹⁰ 羽人

Thus, just as for Aristotle, in Ko Hung's mind gold was a composite thing, and glass artificially made was a model of it. In at least three places in the *Pao Phu Tzu* book he avers in general that gold can be made in a similar way.^a 'I guarantee you that mercury can vaporise and that gold and silver can be sought (successfully).'^b 'The Manuals of the Immortals tell us... that it is in the nature of gold and silver that one can make them.'^c It is true that in several places Ko Hung tells us that owing to inadequate financial resources, communications impaired by wars and tumults, and many other difficulties, he had not been able to carry out all the preparations which he describes,^d but it may be that we should not take this too literally—assuredly he had seen a great deal and noted results which seemed to him highly remarkable, so that he felt that his beliefs, which he put forward so persuasively, were very well founded.

What words did he use for this artificial transformation? A rough census of some fifty occurrences of phrases in the text comes out as follows:

1	<i>shéng chün</i> ¹	produce gold	1
2	<i>té chün</i> ²	obtain gold	1
3	<i>tso chün</i> ³	make gold	11
4	<i>tso huang chün</i> ⁴	make yellow gold	3
5	<i>wei chün</i> ⁵	make to become, or, convert into, gold	4
6	<i>chhêng chün</i> ⁶	successfully turn into gold	9
7	<i>chhêng huang chün</i> ⁷	successfully turn into yellow gold	9
8	<i>hua huang chün</i> ⁸	transform into yellow gold	1
9	<i>tso yin</i> ⁹	make silver	4
10	<i>tso pai yin</i> ¹⁰	make white silver	1
11	<i>chhêng yin</i> ¹¹	successfully turn into silver	4
12	<i>chhêng pai yin</i> ¹²	successfully turn into white silver	2

The general meaning is quite unmistakable,^e but it is worth noting that four of these phrases (nos. 7, 8, 10, 12) should normally mean metallic gold and silver in our sense. That they did not necessarily do so will appear in what follows. We shall see that for Ko Hung the persistent fixity of weight on cupellation was not the only, or the main, property (as it would be for us) which entitled a gold-looking substance to be called gold.

That Ko Hung knew the cupellation process very well there can be no manner of doubt. 'Even with a hundred firings,' he said, 'gold does not diminish, nor will it

^a We have just now heard him ask why, in the light of the multifarious and extraordinary transformations in Nature, anyone should demur to the possibility of making gold and silver from other things (p. 63).

^b Ch. 3, p. 5b, Ware tr. p. 60.

^c Ch. 16, p. 5b, Ware tr. p. 269.

^d See ch. 4, p. 2a, ch. 6, p. 3a and ch. 16, p. 1b (Ware tr., pp. 70, 112, 262 respectively).

^e Some other phrases are occasionally used, such as *tso huang pai*,¹³ 'to make the yellow (metal) and the white' (ch. 16, p. 11a, Ware tr. p. 277), or *ho tso chün tan*,¹⁴ 'to make and compound the golden elixir' (ch. 4, p. 1b, Ware tr. p. 69). The word *ning*¹⁵ sometimes precedes statements such as *chhêng huang chün*,⁷ 'solidifying and successfully turning into' (e.g. ch. 16, p. 7b, Ware tr. p. 272).

¹ 生金

² 得金

³ 作金

⁴ 作黃金

⁵ 爲金

⁶ 成金

⁷ 成黃金

⁸ 化黃金

⁹ 作銀

¹⁰ 作白銀

¹¹ 成銀

¹² 成白銀

¹³ 作黃白

¹⁴ 合作金丹

¹⁵ 凝

decay in the earth as long as the heavens last (*huang chin ju huo, pai lien pu hsiao; mai chih pi thien pu hsiu*).^a This indeed was naturally part of his analogical argument for a parallel immutability of the human organism if 'aureated'. It is best to read the passage in its original context, a discussion of the *Chin tan chih tao*,² the Way of the Golden Elixir (or of Gold and Cinnabar). What he says is as follows:^b

After taking drinks made of sweet barley-sugar (*yü i*)^c one realises the insipidity of sweetish water-plant sap (*chiang hsing*).^d After seeing the peaks of Khun-Lun one knows how small are the hills (of one's homeland). So also once having examined the Tao of the Golden Elixir (or, of gold and cinnabar), one cares no longer to look through the books about the little techniques. Of course, as the Great Medicine is very difficult to make satisfactorily one has to use these lesser things in order to keep going, but though one may take gallons of such tonics, and gain a little benefit, they will never bring a man to longevity and immortality. This is why the oral instructions handed down from Lao Tzu say that all will end in bitter emptiness unless you can get the Cyclically-transformed Regenerative Elixir and the Potable Gold (*huan tan chin i*).^e

Man is kept alive by the five grains; as long as he has them he lives, if they are cut off, he dies. But consider the quality of the finest sort of numinous medicine—would it not be thousands of times better for man than the five grains? The gold elixir is such that the longer it is heated the more marvellous are its changes and transformations. Even with a hundred heatings gold does not lose weight, nor does it decay no matter how long buried. By taking these two things (the elixir and the gold) man can refine his body (*lien jen shen thi*)^f so that he never grows old and never dies. Seeking for these external substances to fortify and strengthen oneself is like the feeding of a flame with oil so that it does not die out.^g (People use) verdigris (copper acetate)^h (ointment) to smear their (legs and) feet when they have to work much in water, so that these do not go rotten, because the strength of the copper protects the underlying skin and flesh.^g But on entering the body the golden elixir permeates the circulatory systems (of the blood and *chhi*); it is not a case of superficial aid like that of verdigris (ointment).^h

^a Ch. 4, p. 2b, Ware tr., p. 71.

^b Ch. 4, pp. 2aff., tr. auct., adjuv. Ware (5), pp. 70ff.

^c This was the sweetening agent used in China before the general introduction of the sugar-cane from India. The saccharification of cereal starch for 'barley-sugar' was performed by the amylolytic enzymes of malt, i.e. by allowing glutinous millet, wheat or barley to sprout, and then working up the maltose and glucose produced before any yeasts had a chance to ferment it further. Hard sugary preparations were called *thang*⁷ and soft or liquid ones *i*.⁸ A good description of the process came a couple of centuries after Ko Hung in the *Chhi Min Yao Shu* of c. +540 (see the translation and discussion of Shih Shêng-Han (1), pp. 77ff.) but the process must have been in use since the beginning of the Han at latest. As malting was employed for this purpose, it is remarkable that in wine-making the Chinese and other East Asian peoples generally preferred to use moulds for the stage of saccharification.

^d The plant here concerned has been identified as *Limnanthemum nymphoides* (B II 47,399), mentioned in the *Erh Ya*. There are several water-plants which have slightly sugarcane-like saps.

^e On the face of it, this sounds like a maxim which could have inspired many research chemists in their endeavours. 'To travel hopefully is better than to arrive, and the true success is labour.' But almost certainly Ko Hung meant the oil to refer to the elixir, which would keep the flame of life burning without ordinary fuel.

^f RP 9.

^g This must surely refer to some ancient anthelmintic prescription, protecting against the attacks of liver-flukes as well as leeches.

^h Surely there is an implicit nuance or reference here to the distinction between surface-films on metals, and true alloys of them.

¹ 黄金入火百鍊不消，埋之畢天不朽

² 金丹之道

³ 玉粒

⁴ 漿荇

⁵ 還丹金液

⁶ 鍊入身體

⁷ 餹

⁸ 飴

Thus the wonderful durability of gold can be communicated to man so that he acquires a similar athanasian quality. But then we are immediately moved to ask whether Ko Hung really believed that his artificial golds had this cupellable property. Or were they in some way different from natural gold?

In every one of his descriptions of elixir preparations involving transmutation he says or suggests that the artificial gold is superior, or at least different, but there is a single passage, outside these, in which he claims that artificial or transmuted gold will withstand cupellation—the very nub of the conflict between alchemists and assayers everywhere down to the +18th century. It is desirable to read his own words:^a

The Manuals of the Immortals say that the essence (*ching*¹) of cinnabar produces gold; this is another way of saying that gold can be made from cinnabar.^b That is why gold is generally found in the mountains below cinnabar deposits.^c If one has been successful in making gold it will be a genuine thing (*tsé wei chen wu*²), the same inside as on the surface, and a hundred refinings will not diminish it (*pai lien pu chien*³). So when the instructions say that nails (*ting*⁴) can be made of it, this is evidence of its strength (*chien ching*⁵). Then one knows that one has acquired the natural process (*tsu-jan chih tao*⁶).

Besides, in view of its powers, why should it be called 'counterfeit' (*ku chhi néng chih, ho wei cha hu*⁷)? 'Counterfeit' can be said of iron that has been coated with malachite so that it has a red colour like copper,^d or silver which has been transformed by white of egg, which renders silver yellow like gold.^e These are instances where the surface has been affected but the interior remains unchanged (*chieh wai pien erh nei pu hua*⁸).

And then he goes off on to other subjects. But the passage is an extremely interesting one, containing an obvious intrinsic contradiction. First Ko Hung says that his artificial gold (or at least some specimens of it) will be cupellable. Our theory of that can only be Chikashige's,^f namely that in some of the preparations auriferous minerals were included in the initial ingredients, so that small amounts of cupellable gold were actually produced. This is not difficult to believe, but then Ko Hung immediately goes on to say that the artificial gold will be so hard and strong that nails can be made of it, though he certainly knew that natural gold is among the softest of metals. The situation might be saved here if *ting*⁴ (nails) were to be read and interpreted as *ting*⁹

^a Ch. 16, p. 5a, tr. auct., adjuv. Ware (5), p. 268.

^b The simplest way of thinking of this is to remember the use of mercury in amalgamation gilding. Yet the end of the paragraph shows that Ko Hung was well aware of the difference between surface 'tingeing' and the making of an internally uniform alloy. One must therefore think rather of some effect of mercury on copper, bronze or brass.

^c Geological and geochemical prospecting which used empirical observations such as this goes far back into the Chou period. We have discussed it already in Vol. 3, pp. 673 ff.

^d This is clearly a reference to the 'wet copper method' (see Vol. 5, pt. 4 below) in which vitriol waters from mines are allowed to flow over iron scrap. There is an exchange of iron and copper ions, and the copper is deposited. Cf. also p. 24 above.

^e A very Hellenistic statement. It shows that the yellowing effect of sulphide or polysulphide solutions was known in Zosimus' time in China just as much as in Egypt. We do not know how the Chinese prepared these, however.

^f (1); see further in pt. 3 below.

¹ 精

² 則爲眞物

³ 百煉不減

⁴ 釘

⁵ 堅勁

⁶ 自然之道

⁷ 故其能之何謂詐乎

⁸ 皆外變而內不化

⁹ 錠

(ingots),^a and some translators have consistently done this,^b but one cannot escape by that route because Ko Hung uses the employment as evidence of the strength. The only solution is to conclude that he was referring to different experiments—in some cases small amounts of gold in our sense were produced, but in others the end-product was a gold-looking alloy of greater hardness than natural gold. He then proceeds to define the term *cha*¹ (artful deception) as meaning all cases of 'tingeing' where the surface films or layers were different from the underlying substance. This is important, for it makes his position rather different from that of the Hellenistic aurifactors. For them, whatever looked like gold externally, whatever had the substantial form, qualities or accidents of gold, was 'gold' in their sense, cupellation objections notwithstanding; but for him, so far at least as we can deduce from this passage, the artificial gold must look like natural gold all through—in other words, though the Chinese alchemists knew 'tingeing' methods well, their products were often of uniform substance, again cupellation objections notwithstanding.

Furthermore, they considered that these were positively superior to natural gold in the quest for longevity and material immortality.^c One's attention is attracted by a very striking passage in which Ko Hung related how he asked his teacher Chêng Yin² why the Taoists did not use natural gold for their elixirs instead of artificial gold,^d made by transformation (*hua*³).^e 'The product', he urged, 'will not be genuine (*fei chen*⁴), and if not genuine it will be counterfeit (*cha wei*⁵).'^f But Chêng Yin replied that natural gold and silver were financially quite out of the reach of Taoists, who had no access to the resources of rich princes and governors; it would be all right if they could get it, but since they could not, they had to make these metals artificially. 'And finally,' he added, 'the gold which is made by transmutation (*hua tso chih chin*⁶) embodies the essences of many different chemical ingredients (*chu yao chih ching*⁷), so that it is superior to natural gold (*shêng yü tzu-jan ché*⁸).'^g Elsewhere also there is a statement that the Potable Gold elixir is better than natural gold, partly because its preparation is attended with such great difficulties.^h It needs money, seclusion in some famous mountain-range, isolation from profane unbelievers and critics, religious ceremonies, purificatory rites; abstention from pungent flavours and fish, to say

^a Also anchors (cf. Vol. 4, pt. 3, p. 657), but that sense is out of place here.

^b Because the expression occurs in several places. Ware (5) did, but Wu Lu-Chiang & Davis (2) did not.

^c Here we may be reminded that the early makers of cupro-nickel in China (pp. 225 ff. below) could well have claimed that it was positively better than silver, for it would not go black with use, as happens when silver sulphide is formed.

^d Ch. 16, pp. 4b, 5a, Ware tr., pp. 267-8. We reproduce the passage in its entirety in Vol. 5, pt. 3 below.

^e One hesitates to write transmutation, or even transubstantiation, in this context, since the philosophy involved was so different from that of the West, but none of these words would be altogether out of place.

^f Note the identity of the second word with that used in the 'anti-coining' edict of -144 (p. 48).

^g Ch. 4, p. 15b, Ware tr., p. 92, cf. pp. 89 ff. This elixir was also a form of philosophers' stone, for projection on mercury to silver and gold was carried out with it. Presumably this must have been some oxidation or deoxidation effect which changed the colour of the surface film of whatever alloy was in the pot. Cf. ch. 16, p. 2b, Ware tr., p. 264, recounting the projection exploits of Wu Ta-Wên⁹ and Chêng Wei,¹⁰ further discussed in pt. 3 below.

¹ 詐

² 鄭隱

³ 化

⁴ 非眞

⁵ 詐僞

⁶ 化作之金

⁷ 諸藥之精

⁸ 勝於自然者

⁹ 吳大文

¹⁰ 程偉

nothing of the fasting; long heating under exact conditions of temperature, needing taxing watch; and finally the indispensability of oral instructions from a genuine adept as teacher.^a

Next come the cases where Ko Hung's artificial gold was said by him to be different from natural gold. One instance of making nails out of it has already been given, but there are at least two more, in both cases solidifying mercury to become gold brightly glittering, 'out of which nails can be made'.^b In another place, an elixir preparation leading to gold may give a metal or substance too hard or too soft, 'if the former, heat it with lard, if the latter, with a mash of white plums'.^c This echoes what may be an earlier text, which also speaks of the 'gold' coming out too hard or too soft.^d Besides this the *Pao Phu Tzu* book has a good deal to say about methods for the softening of gold so that it can be ingested. When gold is placed in the blood-red sap of a plant called *chu tshao*¹ (vermillion herb) it softens to produce 'gold jam' (*chin Chiang*²).^e 'Refined gold' can also be softened by wine.^f Another artificial gold is to be soaked for 100 days in wine made from the *mu ching*³ plant^g or from 'red panicked millet' (*chhih shu*⁴),^h after which it is miscible with other things. Many other similar recipes are given. All this strange-seeming stuff would be readily explained if we were dealing with flakes of stannic sulphide, 'mosaic gold', not metallic gold at all, and this is in fact very probable since one of Ko Hung's most striking procedures is precisely the preparation of this material from tin, 'red crystal salt' (sulphates of aluminium, potassium, iron, etc.) and lime water. Nowadays, stannic sulphide, SnS_2 , is easily made from tin filings, mercury, sulphur and ammonium chloride, and its non-tarnishing flakes, which have the colour and lustre of gold, are used as 'bronze powder', the basis of some modern gold paints.ⁱ We are more and more inclined to think that this product played a larger role in Ko Hung's elixir preparations than has generally been suggested; even in his Potable Gold, though the method of preparation given for it would not fit easily with stannic sulphide, nor the projection to silver and gold which comes at the end.^j Still, it would make sense of a lot of his text hitherto inexplicable.

Thus by and large Ko Hung's artificial golds were better than natural gold, and

^a Cf. especially Ware (5), pp. 51, 271, 319.

^b Ch. 16, p. 5b, tr. p. 269, quoting an earlier *Yü Tieh Chi*⁵ (Jade Tablet Record) of which nothing is known, though a *Yü Tshê Chi*⁶ is in Ko's bibliography (ch. 19, p. 3b). Also ch. 16, p. 7b, tr. p. 272.

^c Ch. 4, p. 13a, Ware tr., p. 88.

^d *Huang Ti Chiu T'ing Shen Tan Ching Chüeh*, TT878, p. 5b; cf. Ware (5), p. 79.

^e Ch. 4, p. 11a, Ware tr., p. 85. The plant is not now readily identifiable.

^f Ch. 4, p. 18a, ch. 11, p. 16b, Ware tr., pp. 95, 198.

^g *Vitex cannabifolia*, R148, CC379, first described in *Ming I P'ieh Lu*; *PTKM*, ch. 36, (p. 114).

^h *Khung et al.* (1), p. 480.1, say *Panicum miliaceum*, presumably a red variety, but could it not be *P. glabrum*, the red-stalked millet (*hung ching ma thang*,⁷ CC 2037)?

ⁱ See Mellor (1), p. 411; A. Smith (1), p. 697; Hiscox (1), pp. 134, 140, 492; Aikin & Aikin (1), vol. 2, pp. 430ff.

^j Ch. 4, p. 14a, b, Ware tr., pp. 89, 90. If *chin*⁸ at the beginning of the procedure were a misprint or cover-name for *hsi*,⁹ tin, it might be another method for making mosaic gold, for both mercury and sulphur may have been present, depending on the interpretation of obscure cover-names (see further the discussion in pt. 3 below). On the other hand there was no heating, the mixture being incubated with acetic acid (strong vinegar).

¹ 朱草

² 金漿

³ 牡荊

⁴ 赤黍

⁵ 玉牒記

⁶ 玉策記

⁷ 紅莖馬唐

⁸ 金

⁹ 錫

generally different from it. Did he then sometimes give them special names? If so, we should be seeing the beginnings of what appear a few centuries later as whole lists of named artificial golds clearly distinguished by the Chinese alchemists as different from natural gold (p. 273 below). Apart from the case of 'potable gold' (*chin¹*) just discussed, there are some other special names. A little later in the same chapter, 'silver' made by projection, on exposure to intense heat and draught, turns into 'red gold' (*hua wei chhih chin²*) hence called 'vermilion gold' (*tan chin³*).^a Plates and bowls made from this will confer immortality on anyone eating and drinking from them.^b Again, in another place, a preparation from potassium alum, mercury, cinnabar, malachite and realgar leads to 'purple sheen gold of superior hue' (*shang sê tzu mo chin⁴*).^c And thereby hangs a tale, but we must postpone it for a few pages till the next sub-section, where we shall be discussing the whole metallurgical-chemical background to Chinese alchemy—here it need only be said that we think we know what this was, a copper-gold alloy with a rich violet or purple surface patina, 'bronzed' to that tint by the action of copper salts and acetic acid (p. 257).

If then we may take Ko Hung as fairly representative of all the early medieval Chinese alchemists, some clear conclusions may be drawn about their beliefs. They were deeply impressed by the wonderful transformations occurring throughout Nature, many of which were quite correctly observed, though others taken over from legend and folklore without sufficient scrutiny. Whether or not the generations of Li Shao-Chün, Chhêng Wei, Mao Ying and Wei Po-Yang (see Vol. 5, pt. 3 below), i.e. from the -3rd to the +2nd century, were fully aware of the decisive nature of the test of the fixity of the weight of gold in the furnace is still very uncertain—they may well not have known about it, for good sociological reasons already suggested, or at least not understood it.^d But by the time of Ko Hung in the late +3rd century knowledge of cupellation is evidenced much more clearly than in the Hellenistic Corpus, so that the acceptance of many artificial golds must have been due less to ignorance than to a deliberate decision to define 'gold' in a different way from the artisans. The maintenance of weight on cupellation was therefore for the Taoists not the only, or the main, property (as it would be for us) which entitled a gold-looking substance to be called gold. Ko Hung must have known that most of the 'gold' which he and his friends made was not cupellable gold, and they knew very well the difference between uniform alloys and surface tingeing, but they were carrying out aurifaction rather than aurification because what they produced was artificial gold according to their own definitions. There was no intent to deceive;^e what mattered most was the golden colour, just

^a Ch. 4, p. 14*b*, Ware tr., p. 90.

^b This is an important statement, harking back as it does to one of the earliest phases of Chinese alchemy, the discussions of Li Shao-Chün with the emperor Han Wu Ti (cf. pt. 3 below).

^c Ch. 16, p. 8*b*, Ware tr., p. 274.

^d This indeed is the view expressed by Chhen Kuo-Fu (1), vol. 2, p. 370.

^e Of course in later times there may have been charlatans and adventurers at court who had no personal faith in the dangerous preparations and elixirs which they offered to people in high positions. But the general impression one gets is that most of them were themselves believers. And the very fact that it was elixirs rather than aurifactive gold as such which constituted the goal of endeavour meant

¹ 金液

² 化爲赤金

³ 丹金

⁴ 上色紫磨金

as with the men and women of the Corpus. And actually, for the attainment of material immortality the artificial gold was, in the eyes of the Taoist alchemists, positively superior to natural gold. There was of course nothing quite parallel to the Peripatetic doctrine of *prima materia* and substantial forms which had so much inspired aurifaction in the West, but the thinking was in a general way similar, for why deny the name of gold to what obviously looked like gold? It may be difficult for us, who understand the nature of tin (Sn) and sulphur (S) as atoms of elements, to see how stannic sulphide can ever have been confused with elementary gold (Au), but what we have to do is to try and wash our minds free of this knowledge, so that we can appreciate how the ingestion of what we might call 'gold paint' (which is what a good deal of the Taoist elixir-taking in the 4th century seems to have amounted to) could be thought of as conveying the imperishability of true gold into the perishable body and spirit of man. Once again, the glitter *was* the gold.

(6) THE DRUG OF DEATHLESSNESS; MACROBIOTICS AND IMMORTALITY-THEORY IN EAST AND WEST

Let us now return once more to the parting of the ways, and take a sixth walk in yet another direction, a path which sets out to explore more fully what is implied by macrobiotics in China and the West. If it was really in Chinese culture that the tie-up between gold-making and immortality first took place, what kind of immortality was it that was meant? Notions about life after death, and the possible avoidance of death, have naturally always been vague in all early civilisations, but it is possible to show by a brief comparative study how far indigenous Chinese ideas differed from those of certain other cultures. Also we can give approximate dates for the various phases of development of these ideas. Essentially what has to be demonstrated is that it was in Chinese culture, and in Chinese culture alone, that the eschatological conditions were right for the origin of real belief in the existence and efficacy of macrobiogens, chemical and physiological elixirs of material immortality. There was no sharp ethical polarisation of other-worldly heavens or hells, and 'the spirits of just men made perfect', together with their bodies in adequately rarefied or etherealised form, would be able to enjoy eternal life either on the earth below or in the constellations of the sky—in any case still fully within the bounds of the natural world. Here there were radical differences from Indo-Iranian-European civilisation. Even though the idea of the elixir spread in due course all over the Old World, its forms were modified and watered down, so how it came to crystallise in the first place matters a good deal. Before speaking, however, of the general comparative range of ideas, and describing the specific Chinese situation, there is a preliminary point to make, namely that in spite of an impression sometimes found,^a there is almost nothing about elixirs or macrobiogens in the documents of the Hellenistic proto-chemists.^b

that it was all the less likely that the Shang Fang artisans would be called upon to test the results. As we shall see, when they did do this, aurifactors were found out (cf. pt. 3 below), but often the aurifactors were quite candid and did not claim the production of cupellable gold, only of fine-looking alloys suitable for imperial gifts.

^a As e.g. in Jung (1), p. 94, (3), p. 154.

^b Leicester (1), pp. 56, 57, concurs.

(i) *Hellenistic metaphor and Chinese reality*

Passages which suggest this line of thought tend to evaporate on close examination. For example, a 'medicine of life' (*pharmakon tēs zōēs*, φάρμακον τῆς ζωῆς) is mentioned in the *Book of Comarius, Philosopher and High Priest, instructing Cleopatra on the Divine and Sacred Art of the Philosophers' Stone*.^a The title may be late, but from its content the text is certainly not among the younger works in the Corpus and could easily be of the +2nd century. At one point, addressing Cleopatra, Ostanēs and his companions are made to say:

In thee is hidden all the marvellous and terrible mystery. Enlighten us, illuminating the elements with thy radiant splendour. Make known to us how the highest descends to the lowest, and how the lowest ascends to the highest, and how the midmost draws near to [the lowest and] the highest so that they are made one with it, [and what is the element which works upon them]. Show us how the blessed waters^b come down from above to awaken the dead, who lie round about in the midst of Hades, chained in the darkness; how the medicine of life comes to them and awakens them, rousing them out of their sleep there; how the new waters that have been produced during their prostration by the action of the fire (lit. light) penetrate them. The vapour supports them; rising from the sea, it supports the waters.^c

And a little further on:

They (the substances, have arisen) similarly from the womb of the waters, and from the body of the air which ministers to them; it has brought them out of darkness into the light, and from mourning to rejoicing, and from disease to health,^d and from death to life.^e And it has clothed them with a divine^f and spiritual glory which before they had not... They have awakened out of sleep and all arisen from Hades...^g

Yet in spite of the mystical language it is generally agreed that these passages are descriptions of reflux distillation in the *kērotakis* apparatus.^h The vapours of mercury, sulphur or arsenic arising from the material at the bottom undergo a chemical reaction with some metal held at the top, and then condense and run down the sides of the vessel so that a cyclical process continues as long as desired. The language is closely related to that of the mystery religions, as also to Hermetic and Gnostic texts and ideas;ⁱ and it has been said that nothing could be more similar lexically than this to the mystical parts of the Pauline epistles.^j Rebirth in 'living waters', the chrism with

^a *Corp. Alchem. Gr.* iv, xx.

^b *Ta hydata eulogēmena* (τὰ ὑδάτα ἐυλογημένα).

^c iv, xx, 8. The square brackets indicate variations among manuscripts.

^d *Kai ex astheneias eis hygeian* (καὶ ἐξ ἀσθενείας εἰς ὑγείαν).

^e *Kai ek thanatou eis zōēn* (καὶ ἐκ θανάτου εἰς ζωήν).

^f Or, of course, 'sulphureous' (cf. p. 252).

^g iv, xx, 16.

^h Cf. e.g. Sherwood Taylor (2), pp. 131 ff.

ⁱ As parallels for 'medicine of life' Hammer-Jensen (2) cites *Poimandr.* 1, 29, from the Hermetic Corpus, and Justin *Hippol. Refut. Omn. Haer.* v, 27 for the Gnostics.

^j Reitzenstein (1), p. 315. There is even in iv, xx, 15 and 16 a twice-repeated reference to the tripartite division into body (*sōma*, σῶμα), spirit (*pneuma*, πνεῦμα) and soul (*psyche*, ψυχή) common to St Paul and the Mandaeans. We discuss the remote parallelism between this and the Chinese doctrine of the three primary vitalities in Vol. 5, pt. 5 below.

which neophytes were anointed,^a and the vapour paralleling the fragrance or perfume of the gnosis,^b all show how near the Hellenistic proto-chemists were to the religious thought of their time. But the 'medicine of life', and even the 'medicine of immortality',^c remained in this part of the world essentially metaphorical, and could frequently be applied as a poetic description of the sacraments, whether baptism^d or eucharist,^e by Christians and Gnostics alike. And the invariable context was essentially 'other-worldly', for none of the Hellenistic religions envisaged a life everlasting in this present world.^f

Another ancient text which can serve as an example occurs in the *Letter of Ostanēs to Petasius*.^g The 'divine' (or sulphureous) water, i.e. the mixture of calcium polysulphides, is thought of as a panacea.^h 'Ostanēs' says:

It is by means of this precious and divine water that the maladyⁱ is treated. By means of it the eyes of the blind see, the ears of the deaf hear, the tongues of the dumb speak... Here is the preparation of the divine water... This water revives the dead and kills the living, it lightens the darkness and darkens the light, it seizes the water of the sea and extinguishes fire...

This passage undoubtedly has to do with the colours produced by surface-films of sulphides on metals, but the rather double-edged properties mentioned in the last sentence gravely detract from any impression that an elixir idea might be present.

^a A perfumed salve was used in the Phrygian mysteries (Firmicus Maternus, *De Errore Prof. Rel.* C, 22ff.). Cf. I Joh. 2: 'Ye have an anointing from the Holy One, and ye know all things...'

^b Cf. II Cor. 2, 14ff.: 'But thanks be to God, which always leadeth us in triumph in Christ, and maketh manifest through us the fragrance of his knowledge in every place. For we are a sweet fragrance of Christ unto God in them that are being saved and in them that are perishing, to the one an odour from death unto death, to the other a fragrance from life unto life...' The idea is Iranian, occurring in the *Avesta* (Yāst, 22) 'a fragrance awakening the dead'; and in the Mandaean Liturgy. It also plays a large part, if with different emphases, in Buddhism, as we saw in Vol. 2, pp. 408ff. That will not concern us again here, but of the possibly great importance of incense-burning in early Taoism something will have to be said shortly (pp. 128ff. below). See the interesting discussions in Reitzenstein (1), pp. 82ff., 313ff., 393, 400.

^c As Jung (2), p. 20, pointed out, the goddess Isis was reputed to possess a medicine of immortality (to *tēs athanasias pharmakon*, τὸ τῆς ἀθανασίας φάρμακον), according to Diodorus, *Bib. Hist.* 1, 25. Cf. Reitzenstein (1), p. 25; McL. Wilson (1), pp. 219, 251.

^d Baptism was often thought of as the 'water of life'. Among the Jewish-Christian Gnostics the Elchasites repeated it frequently and the Ebionites took it every day. For references see Hammer-Jensen (2), pp. 15ff. Occasionally the phraseology comes close to Chinese ways of thought, or appears to do so. Of one of the Gnostics, Menander, it was said that 'his disciples are able to receive resurrection through their baptism into him; they can no longer die but remain ageless and immortal' (Irenaeus, *Adv. Haer.* 1, 23, v; cit. Grant (1), p. 30).

^e Parallels for both of these were found in the environment of early Christianity, neither quite explainable by antecedents in Israel (Reitzenstein (1), p. 82). The very phrase of Diodorus was applied by Ignatius the Syrian to the Christian eucharist. Cf. *Ecclesiasticus*, 6.16.

^f In other words, they were through and through supernatural, as Chinese conceptions never were. The materialist 'drug-in-the-bottle' approach was Eastern, not Western. And even if the great Chinese elixirs killed the body, that was only a stage or gate to continued existence within the world.

^g *Corp. Alchem. Gr.* IV, ii, 1-3. The whole piece ends with an invocation to God and to Christ evidently added in Byzantine times, perhaps in the 6th century, when Olympiodorus was active, but the preceding text would be four centuries earlier.

^h Cf. Berthelot (1), pp. 2, 52, 165ff.

ⁱ Or 'all maladies are', according to the MS. used. Berthelot & Ruelle, vol. 3, p. 251, suggest that 'the malady' meant poverty.

^j It seems to be the destructive distillation of eggs. The shells would have provided the lime.

Surely the writer was simply describing in poetical terms the yellowing, reddening and blackening effects of sulphide films.

A third text has a reference to long life which was thought to be part of the title, but in fact was only a greeting to the reader. This is the curious book which Berthelot & Ruelle entitled *The Chemistry of Moses*,^a rightly analogising it with the Leiden Pap. X, though it also embodies Pseudo-Democritus fragments and includes material on the dry distillation of eggs. Doubtless this book belongs to a Jewish-Alexandrian tradition of proto-chemical practice which we shall meet with again in connection with the apocryphal 'Book of Enoch' and the problem of the origin of the word 'chemistry' (pt. 4), and though it has no title nor writer's name it must be that referred to elsewhere in the Corpus as the *Domestic Chemistry of Moses the Prophet*^b or the *Fermentation Technique of Moses*.^c It opens with the statement that 'the Lord said unto Moses: I have chosen the priest Belseleel of the tribe of Judah to be an artificer in gold, silver, copper, iron, and all workable stones and woods, and to be a master of all the crafts'.^d It then plunges into many recipes. But first there is an invocation to the reader: 'Success to the work, a happy issue to the (processes of) fabrication, an attainment of the (end of) labour, and Length of Days!'^e This 'All Hail' is repeated at the very end of the text,^f it never did form part of the title,^g and it has nothing to do with medicines either of longevity or immortality.

From Hellenistic and Byzantine times this is about as much as one can find. Of course, by the +13th century, especially with Roger Bacon, the elixir idea was clearly implanted in Europe (cf. pp. 14-15 above and Vol. 5, pt. 4 below) even though necessarily restricted by Western cosmology and theology to the attainment of longevity rather than material immortality. It is just this difference in the conception of possibilities open to man that we must now examine. But after the transmission from the Arabs, the 'drug of deathlessness' (*pu ssu chih yao*)¹ was definitely incorporated in European thinking so far as it could be, and one result of this can be seen in the *De Vita Longa* of Paracelsus, written about +1526 and printed in +1562.^h Life, he said, is 'nothing other than a certain embalmed Mumia, which preserves the body from the mortal worms and from corruption just as saline solutions will'—courageous words, with all the dew of the dawn of modern science on them.ⁱ As usual, Paracelsus invented new technical terms, to go with his theory of longevity. The 'iliaster' was a kind of

^a *Corp. Alchem. Gr.* iv, xxii.

^b *Mousēs ho prophētēs en tē oikēia chymēutikē taxis* (Μουσις ὁ προφήτης ἐν τῇ οἰκείᾳ χυμειντικῇ τάξει). The reference is in *Corp.* v, vii, 10, a book on artificial gems completed rather late because there is a reference in it to the Isma'li Arabs, therefore at least +10th century.

^c *Hē Mōseōs Mazza* (Ἡ Μωσέως μάζα), referred to twice in a text attributed to Zosimus (+4th cent.), *Corp.* iii, xxiv, 4, 5. There is also a *Diplōsis of Moses* (cf. p. 18), i, xviii. Cf. i, xii, 2 and iii, xliii, 6.

^d Echo of Exod. 35, vv. 30ff., the same as the master-craftsman of the ark and tabernacle.

^e *Machrochronia biou* (μακροχρονία βίου).

^f iv, xxii, 63.

^g Berthelot (1), p. 123.

^h A long analysis of this will be found in Jung (3), pp. 133ff.

ⁱ On Paracelsian 'balsam' and 'mummy' cf. Pagel (10), p. 101; and on their role in later writers such as John Donne see Mazzeo (1), pp. 108ff. On Hermetic medicine in Donne, Sir Thomas Browne and Henry Vaughan, see Sencourt (1), pp. 146ff.

¹ 不死之藥

prime matter ensouled with all organic potentialities, including life, therefore a universal formative principle; the 'aquaster' a psychical principle with quasi-material attributes, the fountain of the vital spirits.^a These all led to 'natural elixirs' within the body and generated by it, something like those which the Chinese physiological alchemists of the early Middle Ages had sought (cf. Vol. 5, pt. 5), and they could be strengthened and fortified by suitable external means. Now what we need is a survey of the eschatological world-views of different civilisations, to elucidate why the idea of immortality elixirs made so great a fortune in China, and why it could be only partially appropriated by Europe. By that time, however, it had accomplished the task of bringing alchemy to birth, and hence perhaps the greatest single stimulus for man's exploration of the chemical world round about him.

Such a survey will immediately follow, but first the 'embalsamed mumia' of Paracelsus tempts us to a digression which may not be unprofitable. This was no Hellenistic metaphor. The preservation of ancient Egyptian corpses in the tombs long seemed wonderful to pharmacists, and perhaps it was not surprising that such 'embalmed' and mummified flesh was thought to contain some life-conserving 'balsamic' principle.^b From the careful account of Lucas^c we know that the essential process of ancient embalming was desiccation by natron (sodium carbonate with sulphate and a little chloride), but aromatics such as cassia, cinnamon, conifer resins, gum-resins (bdellium and myrrh), etc., were also added in or around the body.^d According to historians of pharmacy, mummy substance became part of the *materia medica* of the Arabs, discussed by al-Rāzī (d. c. +920) and Ibn al-Baithar (+13th century).^e The origin of mummy as a medicament would probably have to be sought in Byzantine Egypt.

What is astonishing is its persistence in European pharmaceuticals—well into the +18th century.^f In Paracelsus' time it was recommended by Brasavola (+1536), in Newton's by Pomet (+1694). It was considered to have great healing powers in cases of fracture and rupture. Not only did Europeans continue to believe in it, but from the mid +17th century onwards the Dutch actually exported it to Japan, 'a sweet-scented balm from Arabia called mommie'.^g Indeed as late as +1786 a leading Rangaku physician, Ōtsuki Gentaku,¹ translated a discussion of it from the Dutch in his *Rokubutsu Shinshi*² (New Discussion of Six Things).^h

^a On 'iliaster' and 'aquaster' see Pagel (10), pp. 88, 112, 227 ff.

^b There may also have been some mental connection here with an empirically appreciated virtue of creosote-like substances such as we should call bacteriostatic. One remembers Bishop Berkeley's book of +1744: *Siris, or Enquiries concerning... Tar-Water*. Hence also Engelbert Kaempfer describing in his inaugural dissertation of +1694 the collection of 'mineral mummy' which he had himself witnessed in Persia (Bowers & Carubba (1), pp. 281 ff.). He actually carried out animal experiments on the healing of bone fractures with it. Similar material (*silajit*), produced in Gilgit, is still used in Unani-Ayurvedic medicine; cf. Maqsood Ali & Mahdihassan (4).

^c (1), pp. 307 ff.

^d On aromatics and perfumes we say a good deal for other reasons, pp. 134 ff. below.

^e Cf. Berendes (1), vol. 2, p. 131.

^f See Wootton (1), vol. 2, pp. 23 ff.; Partington (7), vol. 2, pp. 98, 126, 132.

^g Bowers (1), p. 28.

^h On him and his work see Fujikawa (1), p. 61; Bowers (1), p. 96.

¹ 大槻玄澤

² 六物新志

There is a further lesson for us here. It will hardly be believed that directions for actually preparing mumia or mummy from the bodies of young men whose death had not been due to natural causes were given by Paracelsian physicians. One can find this in Oswald Croll's *Basilica Chymica* of +1609,^a and again in the *Traicté de la Chymie* (+1660) of Nicolas Lefèvre, archiater of Charles II.^b Among other processes the flesh was to be smoked, then treated with myrrh, lignaloës, alcohol and turpentine.^c Li Shih-Chen has often been taken to task by Western writers for his superstitious barbarism in including a *jen pu*¹ (section on medicines of human origin) as ch. 52 of the *Pên Tshao Kang Mu* (+1596), but perhaps if they had known more of their own glass-house they would have been more circumspect in casting their stones.

Actually mummy got into Li Shih-Chen's book, though he did not think much of it. He knew it only from Thao Tsung-I's² *Cho Kêng Lu*³ (Talks while the Plough is Resting), written about +1366 and first printed in +1469, and significantly Thao had heard of it from Arabic sources. The passage runs:^d

Mu-nai-i⁴.^e

According to Thao Chiu-Chhêng⁵ (Thao Tsung-I) in his *Cho Kêng Lu*, in the lands of the Arabs^f there are men 70 or 80 years old who are willing to give their bodies to save others. Such a one takes no more food or drink, only bathing and eating a little honey, till after a month his excreta are nothing but honey; then death ensues. His compatriots place the body to macerate in a stone coffin full of honey, with an inscription giving the year and month of burial. After a hundred years the seals are removed and the confection so formed used for the treatment of wounds and fractures of the body and limbs—only a small amount taken internally is needed for cure. Although it is scarce in those parts the common people call it 'mellified man' (*mi jen*⁶), or, in their foreign speech, 'mu-nai-i'.

Thus Mr Thao, but I myself do not know whether the tale is true or not. In any case I append it for the consideration of the learned.

Thus the content here was Arabic, but the story had got mixed up with a Burmese custom of preserving the bodies of abbots and high monks in honey, so that the Western notion of a drug made from perdurable human flesh was combined with the characteristic Buddhist motif of self-sacrifice for others. Later on (pp. 299 ff.) we shall have occasion to return in another context to the subject of mummification in East Asia. Now the moment has come to draw up our eschatological balance-sheet.

^a Partington (7), vol. 2, pp. 174 ff., 177.

^b Partington (7), vol. 3, pp. 17 ff., 21.

^c Disturbing echoes of all this in comparatively modern India, with a literally thuggish context, even if only in popular belief, will be found in Maqsood Ali & Mahdihassan (4), Mahdihassan (12), pp. 93, 100; Mukerji (1), vol. 2, p. 293.

^d *PTKM*, ch. 52, (p. 110), quoting *Cho Kêng Lu*, ch. 3, p. 16a (the position of the entry varies in different editions), tr. auct., adjuv. R.442. We have conflated the texts but there is very little difference between them. On the *jen pu* see now Cooper & Sivin (1).

^e Franke (17) has thought about the origin of this word, and seems inclined to derive it from Ar. *mulāhida*, a heretical or heterodox person, while Jap. *miira* (mummy) would be from myrrh (Pers. *mirra*). He also suggests that the idea of the honey came from asphalt or bitumen. None of these ideas seems extremely seductive. Why not derive from Ar. *mūmiyā*?

^f Thao says, the Muslims.

¹ 人部

² 陶宗儀

³ 輟耕錄

⁴ 木乃伊

⁵ 陶九成

⁶ 蜜人

(ii) *Ideas about the after-life in East and West*

The state of the dead has been a subject of intense interest to man ever since the beginning of his social life, and no people worried about it more than the ancient Chinese.^a Perhaps the quickest way to explain the variations of belief in different cultures is to draw a schematic diagram such as that in Table 93; one of those charts which humanists are liable to find too summary, but which it is second nature for minds trained in the natural sciences to construct. For the moment let us leave on one side the other-worldly realms of the hells and paradises, residence in which is ethically determined, and speak only of the habitations of men's spirits, more or less disembodied, somewhere within this present world. There were three possibilities: (Ia) upon the earth, either here or somewhere else, (Ib) under the earth, in some subterranean realm, often more or less vague, and (Ic) somewhere in the starry heavens above.^b The essential point was that all men and women, whether good or bad, ultimately went to these universal and comprehensive places.

The idea of a region of the dead somewhere else on the earth is familiar in English literature as the mountains and forests of the 'happy hunting-grounds', derived from the northern Amerindian tribal peoples.^c Others thought that the dead inhabited perpetually their tombs or barrows,^d or entered stones, trees,^e animals or tabu animals.^f Sometimes an 'abode of the blest' was believed to exist in a far-away place, another part of the earth, east or west,^g or another island.^h These beliefs are important for us

^a Though characteristically they avoided for a long time any dogmatism in their visualisations of the after-world. Only the introduction of Buddhism changed this. The book of Bauer (4) on Chinese ideas of paradise etc. appeared too late to be of help to us here.

^b On the relation of these ideas to ancient cosmologies Warren (1) may be consulted.

^c This was shared by the Haitian and Brazilian Amerindians, as also the Dusuns, Idaans and Kapuas of Malaya, together with the aboriginal Australians (McCulloch, 3) and the Todas in India. A life in unknown forests similar to earthly life was equally envisaged by the Bantu, the Ewe, and the Sea Dayaks of Borneo (McCulloch, 2), as further in some pagan Slavonic legends (McCulloch, 6). For many African peoples the shades live on, maintaining contact with the generations that follow, helping or damaging the living, and expecting the filial pieties that are their due (Taylor, 1).

^d This was largely true of ancient Roman religion, where the tomb was *domus aeterna*, and 'ancestor-worship' almost Chinese in its faithfulness (Reid, 2). It held good also in ancient Scandinavian culture, which honoured the 'dweller in the mound' (*haugbúi*) or elf (*álf*), hence the importance of grave-goods and ship-burial (Craigie, 1). One of the ancient Egyptian conceptions had the dead going on living, with bodies preserved by mummification, and fixed at the ages at which they died, in the cities of tombs at the edge of the desert west of the Nile; cf. Barton (1); Baikie (1).

^e So the Dravidian tribes, Gonds and Coorgs, of India, the Ceylonese Veddas, the Papuans, and the Lenguas of Paraguay (McCulloch, 2).

^f So the Oraons in India and the Khé in East Africa (McCulloch, 2). Ancient Japanese legend, in the *Nihongi*, has spirits transformed into serpents (McCulloch, 5), but in general nothing much to say about the after-life. Buddhism of course brought its hells and heavens later.

^g To be sure, these were not always thought of as being open to the spirits of men. In ancient Iranian ideology there was an earthly 'abode of the blest', but souls did not go there. Rather the world was itself periodically peopled from Yima's Enclosure (Yimavara), of which the *Avesta* (Vendidad, ii) speaks (Gray 1). Yima equates with Yama, the later king of hell in Hinduism and Buddhism. All this may be an Indo-Aryan migration legend. Hinduism also had an earthly paradise (cf. Jacobi, 3), Uttarakuru, located far to the north of Mt Meru (cf. Vol. 3, p. 568), where the people were kingless (*vai-rājyam*), but again souls did not go there (*Rāmāyaṇa*, iv, 43, *Mahābhārata*, vi, 7).

^h Prevalent in Melanesia (McCulloch, 3). Babylonian legend, too, had an island in the sea, where Ut-Napishtim ruled and Gilgamesh visited on his search for the herb of immortality (Barton, 1). Cf. Sanders (1); d'Horme & Dussaud (1), pp. 319-20. So also the Celtic 'Land of Youth' (Tir na nÓg)

on account of their close connection with one of the ideas most typical of Chinese thought, continuance of the person, with etherealised body, upon the earth, through aeons of time, though rarely visiting the habitations of men.^a

Still more widespread, however, among ancient peoples was the idea that everyone descended after death to a grey underground world of shadows. This was the dominant conception in ancient Israel (She'ol)^b and ancient Greece (Hades),^c but it is found in

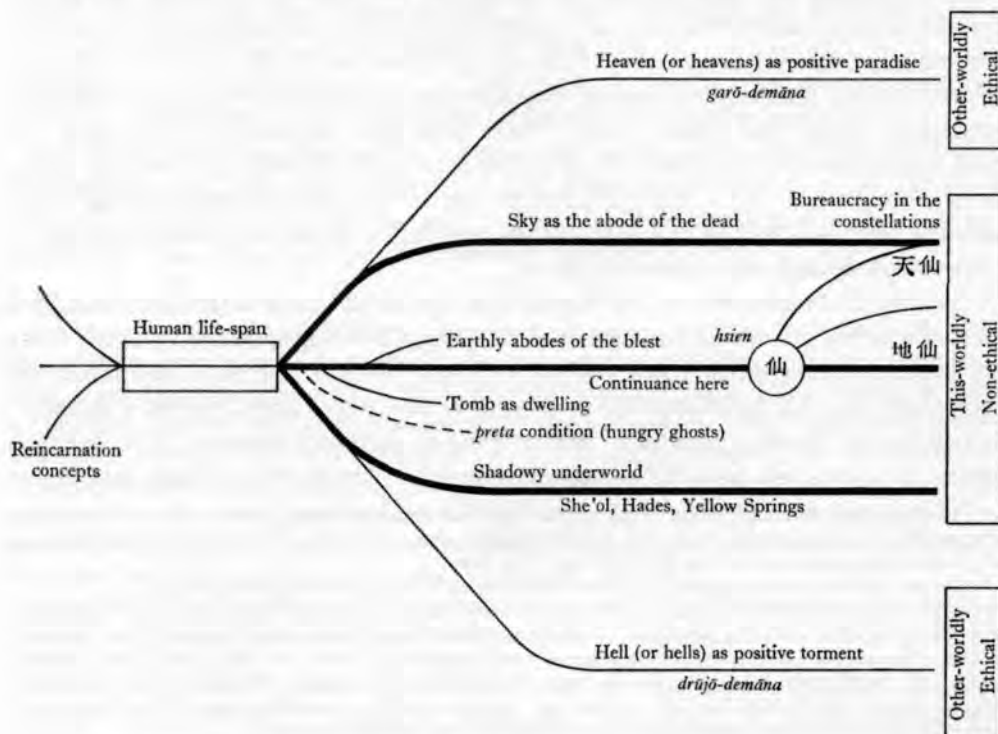


Table 93. *Schematisation of immortality conceptions; development of ethical polarisation*

was sometimes situated beyond the seas, as in the epic 'Voyage of Bran' (McCulloch, 4), which 'Brendan's Paradise' later turned into Christian heaven and hell islands. As for the Mediterranean region, rumours of 'isles of the blest in the Western Ocean', inescapably recalling the isles of Phêng-Lai in the Eastern Sea (cf. Vol. 2, p. 240, Vol. 4, pt. 3, pp. 551 ff.; and Vol. 5, pt. 3 below), go back to the -8th century with Hesiod (*Op. et Di.* 170 ff.) and continue with Pindar (*Jl.* -477) and Euripides (e.g. *Bacch.* 1339 ff.). Presently they were identified with the isles of the Hesperides (probably Madeira or the Canaries). The great Roman general Quintus Sertorius (-132 to -72) was told about the islands at Gades in -82, and intended to sail there, but had to desist because his navy, a Cilician pirate fleet, had more lucrative ends in view (Plutarch, *Vit.*, Langhorne & Langhorne tr., vol. 4, pp. 111 ff.). On all this see Hall (1).

^a One beautiful Chhin or Han description of a Taoist earthly paradise we have already given in translation (Vol. 2, p. 142), and another, from the Chin period, will be found on p. 112 below.

^b The shadowy dreamlike underworld of She'ol, the land of the departed (*reph'āim*), in the Old Testament and the Wisdom Literature, was not a place of punishment or reward. The imagination of the prophets (*nebi'im*) was strongly against any emphasis on the life after death, and deliberately suppressed undue attention to it (cf. Wood (1); Charles (3), pp. 157 ff., 160-1; Oesterley & Robinson (1),

the still more ancient civilisation of Babylonia,^a at the other end of the Old World in China,^b and equally in comparatively primitive societies persisting today.^c It even appears in some medieval cultures.^d After all, the subterranean emphasis arose quite naturally from the fact that burials almost always took place within the bosom of the earth.^e

The third idea, that of a realm of the dead within the world but in the heavens above, was less common than the other two, but it was one at least of those which were entertained in ancient Egypt.^f Various primitive peoples also thought that the souls of the

pp. 222 ff., 233 ff.). Jahweh (Yahwé) was a God of the living and not of the dead; justice and righteousness were the affairs of this world, not another. Here is one of a number of similarities between Judaism and Confucianism. Only in late times, from the 4th century, did any idea of resurrection spread in Jewish thought. The evolution of a positive heaven and hell out of She'ol occurs quite late, one of its first appearances being in the apocryphal 'Book of Enoch' or 1 Enoch (Charles (1), pp. cx, 127-8, (3), pp. 217-18, 292-3). Earlier parts of this we refer to elsewhere (pt. 4), but the portion here relevant can be dated between -95 and -64. We are not forgetting Gehenna, but originally this meant only a real valley (Hinnom) associated with inhuman and idolatrous sacrifices; the concept of it as an otherworldly place of punishment for sinners does not antedate the 3rd century (Charles (4); (1), pp. 55-6, (3), pp. 161 ff.). Persian influence on all these developments in Israel is widely admitted by theological historians, if a little reluctantly (cf. Charles (3), pp. 139 ff.; Cheyne (1), pp. 394 ff.). On the whole subject see further Oesterley & Robinson (1), pp. 79 ff. 243 ff., 246 ff., 352 ff., 360 ff.

As for the idea of a specifically material resurrection, a re-constitution of the body as such, the thought might cross one's mind that Western Asia could have got it from the Chinese conception of material *hsien* immortality which we shall shortly look at with care. It is not in Israel till the time of the Book of Daniel (c. -165). Iranian origins have been suggested, but the more probable view is that it was an individualised version of older religious myths of the Fertile Crescent, coming north from Egypt and west from Mesopotamia. Osiris was killed by Seth (Typhon) and cut into pieces, but Isis put them together again, and Osiris was justified before the other gods by Horus, Anubis and Thoth; cf. Moret (1, 2); H. Schaefer (1). Correspondingly Tammuz (Dumuzi) in Sumeria had to go down to the underworld of Eresh-Kigal, but the faithful Ishtar searched for him and brought him back again with restored body, by decree of Ea. Hence the famous custom of 'mourning for Adonis' and the joy at his resurrection; cf. Pinches (1); Zimmern (2). Both Osiris and Tammuz were in fact gods of green plant growth, and the myths arose from cults of fertility and vegetation. Israel only applied them to everyman, and Christianity naturally followed suit.

^c The shades of the Homeric underworld, Hades (strictly *Aidēs*, 'Aidēs', the Unseen), were bloodless figures without vital strength, though they could feed on the blood of sacrifice, and offerings of men and descendants could somehow help them (Reid, 1).

^a A dark underworld was ruled by the goddess Eresh-Kigal, and Ishtar 'harrowed' it (Rogers, 1).

^b On the She'ol-like underworld of the 'Yellow Springs' we shall have something to say shortly, pp. 84-5.

^c An underworld roughly resembling our own world was imagined by the Kiowa, Seri and Tewa (Amerindian) peoples, the Zulus and Basutos of Africa, as also the Papuans, Polynesians and Torres Islanders (McCulloch, 2). One finds it also, subterranean or submarine, in some versions of the Celtic legends of Tir na nÓg 'in the hollow hills', the dwellings of the *sidhe* or fairy folk, where love-making took a prominent part (McCulloch, 4).

^d Notably the Scandinavians in the Viking age, where the goddess Hel was in charge of a very negative place recalling closely the Hades of the Greeks; cf. Craigie (1); McCulloch (7).

^e We qualify, because of relatively unusual customs such as exposure of the corpse to scavenging birds, or its suspension in trees.

^f The dead were supposed to live among the stars in the firmament, and to accompany the barque of the sun-god through the sky; cf. Barton (1); Baikie (1); Frankfort (4). Or they lived in an underworld (*tuat*), also traversed by the sun-god and illuminated at night, indeed a kind of antipodes. We are not forgetting the Judgment of Osiris, that weighing of the 'souls' so prominent in ancient Egyptian iconography, in the pyramid texts, and in the 'Book of the Dead' (tr. Budge, 4), the earliest recensions of which go back to the middle of the 4th millennium. This was a kind of guide to the world beyond. But down to the middle of the 2nd there was no full ethical polarisation; those who could successfully pass the test of innocence, those whose hearts balanced on the scales the feather of Maât, goddess of truth and uprightness, were indeed admitted to the perpetual company of the gods, but the wicked were

dead found a home in the stars.^a Again, this belief is important for us because of the prominent place it took in Taoist religious philosophy, for the 'perfected immortal' could in time arise to the constellations and take his place in the ranks of the celestial bureaucracy whose offices and palaces they were.

So far there has been no ethical polarisation, but all these ancient ideas of universal 'public' places were invaded gradually by another pattern of conviction, that of a judgment which would separate good and evil men, rewarding the former and punishing the latter.^b Thus there entered in a motif essentially other-worldly, salvation *vs.* damnation, the theme of heaven as a positive paradise (IIa) and hell as a place of permanent torment (IIb), neither being thinkable within the world that is looked upon by the eyes of men. Initial or partial steps in this direction can be found in several cultures. For example, the Greeks developed a visualisation of separate departments within the after-world—the Elysian Fields for heroes like Menelaus and sages like Teiresias, while a vague region of woe harboured Prometheus, Sisyphus or Tantalus, suffering their age-long pains or performing their eternal fruitless tasks.^c But the real source of this ethical polarisation was clearly Iranian dualism, spreading gradually outwards over all parts of the Old World. From the oldest Avestan sources onwards there is a consistent picture of an upper paradise of the just, in four levels, the *garō-demāna* or 'house of song' of Ahura Mazda; standing over against the *drūjō-demāna* or 'house of lies' of Ahriman (Angra Mainyuš), also in four levels.^d The pattern is Indo-Iranian, for the Vedas of the late — 2nd millennium clearly think of a heaven in the presence of the gods outside this world, and an abyss or underworld, also outside; places to which men are dismissed in accordance with their actions. Then in the *Samhitās* and *Brāhmaṇas* the heavens and hells (*nārakaloka*) are particularised and multiplied, especially after the — 3rd century, only the *Upaniṣads* developing the ideas of reincarnation upon earth and the annihilation of the personality in the case of sages. Any who continue to haunt the earth are working out the purgatorial existence of 'hungry ghosts' at once devoured by a monster called *Ām-mit*, or beheaded and cast into a lake of fire—in other words they were annihilated and ceased to exist; cf. Budge (4), p. cvi; Petrie (5); McCulloch (9), p. 374; Cerny (1). Of all 'pie in the sky' doctrines this was surely one of the most humane. But from the middle of the — 2nd millennium new and different texts emerged, the 'Book of the Gates' and the 'Book of What is in Tuat'; according to these the 'souls' of evil men were not extinguished but sent to perpetual torment in a region of the underworld called Amenti; cf. Hall (1), p. 460; Cerny (1).

As we shall see in a moment, the main focus of ethical polarisation for Asia seems to have been Avestan Persia, and the dates seem too early for mutual influence between Persia and Egypt, so the Egyptian development would appear to have been an indigenous one. We are much indebted to Prof. J. R. Plumley for advice on this subject.

^a E.g. the Patagonians and the Abipones (McCulloch, 2). Cf. di Santillana & von Dechend (1).

^b This was what Charles called the 'moralisation of the future' (3), p. 157.

^c See Reid (1). On some views, the Elysian plain was on earth, not in Hades, but no one knew how to get there (Hall, 1). As time went on, e.g. in Plato, there is more emphasis on the region of woe, judged by Minos, Rhadamanthus or Aeacus. Perhaps this was Persian influence. Ideas of reincarnation and the transmigration of souls also make their appearance, probably due to Indian influence. Another example of incipient ethical polarisation might be taken from pagan Viking Scandinavia, which sent its warriors to feast with Odin or Thor in Valhalla, while noble women were gathered in Freya's garth; cf. Craigie (1); McCulloch (7).

^d See Casartelli (1). It is not generally known that a Dantesque epic, still favourite among the Parsis, the *Artā-ī Vīrāf Nāmak*, was written in the +5th or +6th century. The writer was guided through the 9 heavens and the 103 hells by the Avestan angel Sraosha.

(*pretas*), while other spirits may become demons (*rakṣasas*), also capable of appearing on earth.^a

This whole picture was taken over and developed in different ways by Buddhism,^b by Israel, by Christianity^c and by Islam.^d The Buddhist 'life-courses' (*gati*) included the inhabitants of the 136 hells, *asuras*, *pretas*, animals, men, gods, and the inhabitants of the 14 heavens.^e Under reincarnation spirits were constantly ascending and descending in the scales.^f Such was the form, therefore, in which the ethical polarisation principle found its way to China from the +2nd and +3rd centuries onwards,^g but it is highly significant that nothing of the kind had been present there previously, i.e. at the time when the earliest explorations in alchemy and early chemistry were being undertaken (-4th to +1st centuries). What this means will become clearer as we go on. What we have to look at now in adequate detail is the pattern of thought about life and death which did reign during these centuries.

Indigenous China's position in the scheme of things portrayed in Table 93 was somewhat as follows. By and large, Chinese culture was fundamentally attached to all this-worldly levels. The people of the Shang period (late -2nd millennium) seem to have had very little idea of where one went to after death, but they were distinctly afraid of the family spirits, and many of the oracle-bone inscriptions are enquiries as to whether particular illnesses or misfortunes were or were not being caused by particular ancestors who were, for some reason or other, dissatisfied.^h Gradually the visualisation grew up of a dark shadowy realm not unlike our own world, but underground somewhere in the neighbourhood of the 'Yellow Springs', a name for the Chinese She'ol or Hades which became general early in the -1st millennium. Servitors and possessions were needed there, hence the human sacrifices of the Shang royal burials, soon commuted to wooden effigies like the ancient Egyptian *ushabti* figures; and hence also the abundance of bronze vessels and tomb-furniture in model form which has been the joy of Chinese archaeology ever since the Sung. Hence, again, the long tradition of sacrificial 'ancestor-worship', which lasted unflinchingly down, withstanding all argument, to contemporary times.ⁱ Gradually also theories of the spiritual

^a On all this see Keith (7).

^b See the summaries of Thomas (2) and de la Vallée Poussin (9). In the Tibetan Mahāyāna form, costly 'masses for the dead' were a great feature, and there were 8 cold as well as 8 hot hells (Waddell, 4).

^c See Harris (1) for a brief summary. On the Persian influence on Israel and Judaism in this respect see Oesterley & Robinson (1), pp. 312ff., 388ff., 391, 394ff.

^d Wood (2). Here paradise (in 7 levels) was agreeably 'sensual', a place of beauty and perpetual youth, but hell also had 7 levels.

^e Six 'sensual' (*kāmaloka*), four retaining forms (*rūpaloka*), and four beyond all forms (*arūpaloka*). In nirvana all existence, even heavenly, was left behind.

^f Cf. Vol. 2, pp. 421-2.

^g In later times the torments of the damned in hell played a large part in Chinese folk belief, as witness the models often formerly to be seen in city-god temples—I remember particularly the set at Tunhuang. From the Liu Chhao period onwards many Dantesque stories of visits to the underworld were written, on which see Maeno Naoaki (1), and one at least has been translated, by Duyvendak (20); cf. Vol. 2, p. 126. Hell got worse and worse as the centuries went on.

^h See the study of Shima Kunio (1).

ⁱ How enlightened this was has been well put by Walshe (1). 'In the Chinese classics it is repeatedly stated that the real value of the offering is to be measured by the spirit in which it is made; the true sacrifice is the heart of the offerer, without which the most elaborate ceremony will utterly fail to secure

parts of man arose, and it is significant that what emerged was not a unitary soul but a group of two, and then more (ten), partly ouranic and Yang in character, partly chthonic and Yin. In accord with the basically this-worldly ethos of the Chinese, life on earth was found good and greatly treasured, so that from the Shang period onwards emphasis on longevity grew and grew, length of life in some quiet hermitage or surrounded by one's descendants being the greatest blessing that Heaven could confer. Why should it not continue for ever? Why not indeed; and after the beginning of the -4th century the conviction everywhere spread that there were technical means whereby men could enlarge their length of days so much as to be virtually immortal, not somewhere else out of this world, nor in the underworld of the Yellow Springs, but among the mountains and forests here and for ever. Something happened at this time to strengthen greatly this belief, perhaps a message from Babylonia, Persia or India about a drug-plant, herb or medicine of immortality, even perhaps slightly misunderstood so as to interlock with Chinese world-views. The result was a great wave of activity concerned with what is sometimes called the cult of the *hsien*,^{1,2} a distinctively material immortality in which the body was still needed, preserved in however ether-ealised or 'lightened' a form, whether the deathless being remained among the scenic beauties of earth or ascended as a perfected immortal to the ranks of the Administration on high—in either case within the natural world suffused by the Tao of all things.

This is the point where we rejoin the history of chemistry. It is vital that during the formative centuries China was not in the grip of an ethically polarised system, a sieve which separated the sheep from the goats into two streams and funnelled them out of this world into pure light and pure darkness. Perhaps there was a deep recognition in the mind of ancient China that in every individual the good and the evil were inextricably mixed. Now a drug-plant or a mineral-metallic elixir is only naturally thinkable in the context of radical continuance; it could surely never be expected to ensure the attainment of disembodied other-worldly bliss, or a protection against disembodied other-worldly torment, especially if both were considered deserved. It is essentially a medicine, and just as medicines have to do with the maintenance or restoration of health here and now, so also an elixir had to do with the maintenance of health here and for ever. The fact that gold and silver do not spontaneously oxidise in air was only a minor consideration, an analogy very easy to understand once the cosmological framework permitted of a permanent 'going-on', in fact almost a side-issue. Yet all alchemy in all civilisations, and all that that implied, was born, we believe, from this specific situation and no other.

the approbation of the spirits.³ And the consensus was, too, that though we could not know very much about their condition, the spiritual condition of the sacrificers themselves was profoundly benefited by their acts and thoughts in these liturgies. I suppose that by now it is hardly necessary to point out that the word 'worship' in the famous phrase means little more than veneration and respect such as is voiced in 'His Worship the Mayor', and 'with my body I thee worship' in the marriage rite of the Church of England. It is also hardly necessary to recall the unnecessary fuss about ancestor-worship in the controversies among the missionaries of the Latin Church in China in the seventeenth and eighteenth centuries.

¹ 僊² 仙

Since *hsien* immortality was distinctively under the aegis of religious Taoism the question may arise at this point how it could have been reconciled with the cultivation of that ataraxy, *ching hsin*¹ (calmness of mind, and serenity undisturbed by any external circumstances, including death), which was so prominent in philosophical Taoism.^a But this is only a seeming paradox. Inheriting perhaps a traditional Confucian prejudice, we probably tend to make altogether too sharp a distinction between Taoist religion and Taoist philosophy.^b The latter was, in terms of our own past, Democritean, Epicurean and Lucretian; its peace of mind, its banishment of fear, was the product of a clear-eyed contemplation of Nature, a theory of the Tao or immanent Order of Nature, a mystical acceptance of and incorporation in Nature, and a nomenclature for all the phenomena of Nature, hence in this last it joined continually with the developing natural sciences and practical techniques. Such techniques, sometimes real, as of butchers, wheelwrights, boatmen, buckle-makers, musicians and mathematicians;^c sometimes romantically imagined, as flying and riding on the winds,^d or performing, like Prospero, various magical operations, confining a spirit in a bean and making images speak;^e are met with on every other page of Taoist philosophical books. Now longevity was obviously a technique, and material immortality simply a greater one. No successful technique could go against the grain of Nature (*wei*²); in order to work it must go along with it, hence the famous injunction *wu wei*,³ not 'inaction' but 'no action contrary to Nature'.^f The real question at issue here then is whether extending human life indefinitely was 'going against Nature', and the answer is that it was not, because Nature's time-scales were variable. If the slow growth of minerals and metals in the earth could be speeded up enormously by the alchemist,^g the short life of man could be slowed down and drawn out so as to be unending—the elixirs were, in Sivin's excellent phrase, 'time-controlling substances'. Immortals occur already in the *Chuang Tzu* book, and what is more important, a great emphasis on the relativity of life-spans;^h the 'mosquito of a summer evening' cannot compare in length of life with the dragon, the huge *phêng* bird has horizons closed to the little sparrows hopping from twig to twig. Ataraxy was of course desirable and laudable, but if there really were techniques for living on and on, then to use them was only following Nature in another way. A man might avoid death without going outside Nature or acting in any way contrary to the Tao if he found out or followed certain natural processes not usually known to men or practised by them. And one should not overlook either the fact that the calmness of mind praised by Taoist philosophers, recluses and adepts, was itself an admirable geriatric prescription. Gradually indeed, as these techniques developed, and as belief in them deepened, man's individual responsibility came to be more and more insisted on, and we shall see in the sub-section on physiological alchemy

^a Cf. Vol. 2, pp. 63 ff.

^b There were a great many people who made valuable contributions to both traditions, for example Chang Chan* (*fl.* +320 to +400), the editor of the *Lieh Tzu* book (and perhaps the writer of some of it), who also wrote a work on Taoist physiological alchemy, including the sexual techniques involved.

^c Vol. 2, p. 121.

^d Vol. 2, pp. 65 ff.

^e Vol. 2, p. 444.

^f Vol. 2, pp. 68 ff.

^g Cf. Vol. 5, pt. 4 below.

^h Vol. 2, p. 81.

¹ 靜心

² 爲

³ 無爲

⁴ 張湛

(Vol. 5, pt. 5 below) how the conviction spread that 'my life-span depends on what I decide to do about it, and not upon any decree of Heaven'. Yet even this was still in a way a following of Nature, for the Taoists were always Baconians too; *Natura enim non imperatur nisi parendo*, 'we cannot command Nature except by obeying her'.^a

What can one say about the Yellow Springs (Huang Chhüan¹)? If one asks any educated Chinese friend about this place of the dead, he will immediately recall the touching story of Chuang,² the ruling prince of Chêng³ State, which occurs in the *Tso Chuan* under the date of -721. His father, Prince Wu,⁴ had married a princess of Shen⁵ named Wu Chiang,⁶ and of their two sons she preferred the younger one, Kungshu Tuan⁷; but Chuang having ascended the throne Tuan revolted and took many cities before being conquered by his elder brother. At one point in this family quarrel Tuan intended to besiege Wu Chiang in the Chêng capital, and she would have opened the gates to him, but was prevented by loyalists from doing so. Now read on, as the novellettists say.

Chuang then shut up (Wu) Chiang in the city of Ying,⁸ and swore that he would never look upon her again until they both came to the Yellow Springs. Afterwards he repented of this oath.

One Khao Shu,⁹ who was Warden of the Marches in the Valley of Ying, heard of this and went to court to offer some present to the prince. The prince made him stay to dinner, and noticed that he laid aside some of the food, so he asked him why. 'Your servant', answered Khao Shu, 'still has a mother, and she likes to taste of all the best things that I am given to eat. She has never tried this princely dish; pray take no offence if I keep a little for her.'

The prince looked sad, and presently said, 'Ah, you have a mother for whom you keep titbits. Alas, alas, I lack any parents, I have no mother.' Khao Shu enquired how this was, and the prince told him the reason of it, his oath (after the civil war). Whereupon Khao Shu remarked with a cheerful face, 'Why should the prince grieve about his oath? If you would dig a tunnel in the earth going down to some springs (as is done for royal tombs), you could arrange to meet your mother there (*jo chhüeh ti chi chhüan, sui erh hsiang chien*¹⁰). Who could then say that your oath had not been kept?'

The prince followed this advice, and entered the tunnel chanting, 'In this great subterranean place joy and concord will be found.' His mother came forth from it chanting, 'Beyond the subterranean world our hearts are bursting with happiness.' And from that moment they resumed their relations of mother and son.

Lords and masters (in time to come will) say that the filial piety of Khao Shu of Ying was perfect, for by his love for his own mother he awakened that of Prince Chuang (of Chêng). . . .^b

From this a number of things are to be learnt. In the -8th century the idea of a shadowy underground home of the dead was fully accepted, and not thought of as very far

^a *Novum Organum*, aphorism no. 129; cf. Vol. 2, p. 61. The problem dealt with in this paragraph was debated at the Bellagio Conference on Taoism (1968), arising out of the contribution of Graham (7), and the discussion there has been of help in formulating it now. An account of this conference has been given by Holmes Welch (3).

^b *Chhun Chhiu Tso Chuan*, Duke Yin, 1st year, tr. Couvreur (1), vol. 1, pp. 7 ff., eng. auct. mod. One cannot of course accept precise dates for *Tso Chuan* stories and speeches.

¹ 黃泉

² 莊

³ 鄭

⁴ 武

⁵ 申

⁶ 武姜

⁷ 公叔段

⁸ 穎

⁹ 考叔

¹⁰ 若闕地及泉隧而相見

below the surface of the earth. Perhaps the colour was suggested by the yellowish-red deposits around chalybeate springs, and of course in later Five-Element theory Earth took the centre position and corresponded with the colour yellow, hence later associations with terrestrial imperial power.

The expression 'yellow springs' was often used of underground regions in general. In the late -4th century there was a saying that 'the earthworm eats the dry soil above and drinks of the yellow springs below'.^a Significantly for our theme, however, Chuang Chou about the same time spoke of himself, as a liberated immortal, 'now walking by the yellow springs below, now soaring up to the great empyrean'.^b Towards the end of the +1st century, the records of a congress of naturalists and ritualists say that 'the *chhi* of the Yin accumulates and lies in the north below the yellow springs'.^c And about +82 Wang Chhung remarks that 'people naturally don't like the dark. Who would want to be a miner digging galleries in the vicinity of the yellow springs?'^d But the Yellow Springs as the home of the dead persisted continually through the history of Chinese thought. A long discussion about it can be found in the *Kuan Tzu* book (-4th century) where Duke Huan of Chhi¹ is represented as conversing with Pao Shu² and Kuan Chung³ on the subject.^e And in the *Chhien Han Shu* (c. +100) there is an ode recorded on the death of Prince Li of Kuang-ling:^f

The Yellow Springs below are dark and cryptic,
But man being born, so also must he die,
Why then be sad and of a mournful heart?^g

This is the pattern set for later times, when innumerable references could be adduced, especially in poetry, for the Yellow Springs as the home of the dead. But so little is ever said about their condition there, and what they do, that it is quite safe to analogise Huang Chhüan with She'ol and Hades.^g

(iii) *The hun and pho souls*

In all discussions such as these the question of the 'soul' (or souls) and its relation to the body is sooner or later bound to arise. Especially in the understanding of the ancient Chinese conception of material immortality it is important to recall that no theory of a single indissoluble individual soul spontaneously arose there; on the contrary from earliest times (or as far back as we can penetrate) each person was considered to have at least two, of air, as it were, and earth, respectively compact.^h The

^a *Mêng Tzu*, III, 2, x, 3, tr. Legge (3), p. 161. Also *Hsün Tzu*, ch. 1, p. 4b, tr. Dubs (8), p. 35.

^b *Chuang Tzu*, ch. 17, tr. Legge (5), vol. 1, p. 389.

^c *Pai Hu Thung Tê Lun*, ch. 9, p. 9b, tr. Tsêng Chu-Sên (1), vol. 2, p. 429.

^d *Lun Hêng*, ch. 38, tr. Forke (4), vol. 2, p. 99.

^e Ch. 20, p. 6b.

^f Ch. 63, p. 15b.

^g As in Greece and Rome, moreover, the dead could be helped by sacrifices. One of these, the *yü chi*,³ was 'to make the dead peaceful in the other world'; Kurihara Keisuke (1) has devoted a special study to it, drawing on the *I Li* and its commentaries.

^h Cf. Vol. 2, pp. 153ff.

¹ 齊桓公

² 鮑叔

³ 管仲

⁴ 廣陵厲王

⁵ 厲祭

ouranic component, the *hun*¹ soul, came from the upper air and was received back into it, while the chthonic component, the *pho*² soul, was generated by the earth below and sank back to mingle with it after death.^a This double system was entirely congruent with the Yin-Yang antithesis of two fundamental forces in the universe, but we can trace it back a good deal earlier than the systematisation of the Yin and Yang philosophy by the School of Naturalists in the latter part of the -4th century.^b In later long-continuing tradition the *hun*¹ was regarded as the archaeus (*chu tsai*³) of the seminal and mental essences (*ching shen*⁴),^c while the *pho*² was thought to be the archaeus of the actual flesh and bones of the body (*jou thi*⁵).

What must be one of the oldest discussions of *hun* and *pho* occurs in the *Tso Chuan* for the year -534, when the scribes reported a discourse of Kungsun Chhiao⁶ (i.e. Tzu-Chhan,⁷ d. -521, a learned statesman of Chêng) on embryology. He said:^d

When a foetus begins to develop, it is (due to) the *pho*.^e (When this soul has given it a form) then comes the Yang part, called *hun*. The essences (*ching*⁸) of many things (*wu*⁹) then give strength to these (two souls), and so they acquire the vitality, animation and good cheer (*shuang*¹⁰) of these essences.^f Thus eventually there arises spirituality and intelligence (*shen ming*¹¹). . . .

Thus the line drawn between spirit and matter was—as one would expect from all Chinese thinking—extremely vague.^g The *hun* and *pho* souls were quite like *chhi*, very subtle matter on the verge of being non-material.^h The affiliations of *hun* and *pho* are clearly stated in the *Li Chi* (Record of Rites), that complicated text stabilised

^a Before proceeding any further we wish to record our conviction that the use of the word 'soul' in translating *hun* and *pho* is essentially inappropriate and unsatisfactory; we employ it only because we have been unable to find any better Western alternative. Often we enclose it in quotation-marks, but since that would be too tedious if systematically done, the reader is invited to assume their presence. Occasionally *animus* may be used for *hun*, and *anima* for *pho*, but we have avoided adopting this as a basic usage because of the highly technical (and different) meaning of these terms in some systems of modern psychology.

Of the home-faring of ouranic and chthonic components there are of course traces in all the civilisations. Compare the words of Cleopatra—just before the bite of the asp:

'I am fire and air; my other elements
I give to baser life . . . ' *Antony & Cleopatra*, Act v, sc. 2.

^b Vol. 2, pp. 232ff.

^c Later on it will be seen that in the great system of physiological alchemy (*nei tan*) these became two out of the three original or primary vitalities (Vol. 5, pt. 5).

^d *Chhun Chhiu Tso Chuan*, Duke Chao, 7th year, tr. auct., adjuv. Couvreur (1), vol. 3, p. 142.

^e This word, it is interesting to find, had another old meaning, for it is to be found in the *Shu Ching* as an astronomical technical term for the dark part of the moon, equivalent therefore to another ancient word with a very divergent fate, *pa*.¹² The *Kuang Ya* dictionary of +230 perpetuated these, but they were afterwards forgotten.

^f A memorable phrase, reappearing, for example, in the *Yü Phien* dictionary of +543.

^g We return to this shortly, pp. 92-3 below.

^h I always remember the tone of amused contempt for the 'loose thinkers' of the scientific world, with which my friend Prof. Michael Oakeshott, when in his youth a member like myself of the B.A.'s table at Caius, used to say: 'you can't turn matter into spirit just by making it thin'. But that was what the Chinese philosophers did throughout their history, in so far as they would have admitted any distinction at all. The debates of 'materialism' and 'metaphysical idealism' were as dust and ashes unto them.

¹ 魂
⁷ 子產

² 魄
⁸ 精

³ 主宰
⁹ 物

⁴ 精神
¹⁰ 爽

⁵ 肉體
¹¹ 神明

⁶ 公孫僑
¹² 霸

towards the end of the +1st century but containing much material that dates as far back as the -5th. *Hun chhi kuei thien*,¹ it says,^a 'the *hun* or *chhi* reverts to the heavens', and *hsing pho kuei ti*,² 'the *pho* or *hsing* reverts to the earth'.^b And in another place,^c *hun shen chih shêng yeh*,³ 'the *hun* is the plenitude of the spiritual', while *pho kuei chih shêng yeh*,⁴ 'the *pho* is the plenitude of the demonic'.^d To this the Chêng commentary adds that the sensitivity of the eyes and ears is a manifestation of the *pho* (*erh mu chih tshung ming wei pho*).^e

It is then interesting to read the entry on *hun* and *pho* in the *Pai Hu Thung Tê Lun*⁶ (Comprehensive Discussions in the White Tiger Hall) written about +80. It runs as follows:^f

What do the words *hun* and *pho* mean? *Hun* expresses the idea of continuous propagation (*chhuan*), unrelenting flight; it is the *chhi* of the Lesser Yang, working in man in an external direction,^g and it governs the nature (or the instincts, *hsing*).⁸

Pho expresses the idea of a continuous pressing urge (*po*) on man; it is the *chhi* of the Lesser Yin, and works in him,^h governing the emotions (*chhing*).¹⁰

Hun is connected with the idea of 'weeding' (*yün*), for with the instincts the evil weeds (in man's nature) are removed.

Pho is connected with the idea of 'brightening' (*pai*), for with the emotions the interior (of the personality) is governed.ⁱ

What do the words *ching*¹³ (seminal essence) and *shen*¹⁴ (mental essence) mean? *Ching* is connected with the idea of 'quietness' (*ching*); it is the *chhi* of emission and generation under the Greater Yin. It corresponds to the transforming power of water, which leads to pregnancy and life.

Shen on the other hand is connected with the idea of 'blurred confusion' (*huang hu*); it is the *chhi* that is under the Greater Yang. [It corresponds to the transforming power of fire, which sets all things in order.]^j In general one may call it the origin of the changes and transformations in all the limbs (and organs) of the body.

^a Ch. 11, p. 47a, cf. Legge (7), vol. 1, p. 444. This must have been a commonplace already by the beginning of the Han.

^b The *Huai Nan Tzu* book (-120) similarly says (ch. 9, p. 1b) that the *hun* is formed from the *chhi* of the heavens, and the *pho* from that of the earth. Kao Yu, commenting in +210, points out the Yang and Yin character of the two. Elsewhere (ch. 16, pp. 1a ff.) Liu An has a dialogue between a *hun* and a *pho*.

^c Ch. 24, p. 48a. Cf. Legge (7), vol. 2, p. 220.

^d One generally translates the common ancient binome *kuei shen* as 'gods and demons' or 'gods and spirits' (reversing the order of the Chinese words). The dead, if not at peace, were liable to become *kuei*, along with nature-spirits of a more or less malevolent character. The *shen* tended to be *genius loci* or *lares* and *penates* spirits, though some would be gods of formidable puissance. How the Indian ideas of spirits were integrated into this framework by the Buddhists has been the subject of an interesting study by Michihata Ryōshū (1). On the Neo-Confucian rationalisation of the *kuei shen* concepts cf. Vol. 2, p. 490. For a close European parallel see Walker (2), p. 27.

^e The *hun* and *pho* souls also figure in the *Tao Tê Ching*, which must be of the -4th century. We discuss this in pt. 5 below.

^f Ch. 30, p. 4b, tr. auct., adjuv. Tsêng Chu-Sên (1), vol. 2, p. 571.

^g Presumably in motor nervous and muscular activity, as we should say.

^h Presumably in sensory and perceptive activity, as we should say.

ⁱ These 'explanations' derive, at least in part, from the similarity in the ancient pronunciations—sounds like *giwyn* and *pak* respectively—as Professor Hulsewé reminds us.

^j Supplied conjecturally to satisfy the antithesis.

¹ 魂氣歸天

² 形魄歸地

³ 魂神之盛也

⁴ 魄鬼之盛也

⁵ 耳目之聰明爲魄

⁶ 白虎通義論

⁷ 傳

⁸ 性

⁹ 迫

¹⁰ 情

¹¹ 芸

¹² 白

¹³ 精

¹⁴ 神

¹⁵ 靜

¹⁶ 恍惚

Thus *hun* goes with *shen* and *pho* with *ching*. Peering as far as one can into these ancient psycho-physiological ideas, one gains the impression that the distinction was something like that between what we should call motor and sensory activity on the one hand, and also voluntary as against vegetative processes on the other. This is supported by a phrase in the *Chuang Tzu* book concerning meditation, and datable late in the 4th century, 'be still as if you had no *hun*'.^a But one should be wary of pressing such interpretations too far. There is also the point that on these general theories the dwellers in the land of the Yellow Springs could have had their *pho* souls but not their *hun*, and such a state of motor paralysis might have been comforting for any of the living who were inclined to inherit ancient anxieties about the powers of ancestors to work harm on the living. But the Yellow Springs was a concept much more poetical than philosophical or scientific,^b and though we do not know of any extended Warring States or Han discussion of the point, it seems probable that the *pho* souls as well as the *hun* were more often thought of as dissipating and dissolving in the *chhi* of the heavens and the earth like drops of wine poured into water. This also can be supported from *Chuang Tzu*; to form man's being the *chhi* is collected and agglomerated (*chü*), when he dies it is dispersed (*san*), that is all.^c And one remembers the moving account of what Chuang Chou said after the death of his wife.^d Lastly, the idea of double or multiple 'souls' cannot have been unique to ancient Chinese culture, but it would take us too far to examine how widespread it was.^e

At some time during the Later Han period or soon afterwards^f the number of *hun* souls was definitively fixed at three and the number of *pho* souls at seven.^g It is a little difficult to ascertain the reason for this, since fives and sixes (if they corresponded to the viscera) would have rather been expected. There may have been a macrocosmic or astrological significance, for the seven regulators, or luminaries (the sun, moon and planets, *chhi chêng*,³ *chhi yao*⁴), and the seven stars of the Great Bear (*chhi hsing*⁵) spring to mind; but it is surely more likely, in view of what we have surmised about the sensory-perceptive quality of the *pho*, that sense-organs and emotions dictated it.

^a Ch. 11, cf. Legge (5), vol. 1, p. 302. Of course he meant turning off the sensory apparatus and the flow of images, but that could only be done in immobility.

^b It also probably belonged more to the folk religion of the common people than to the speculations about the constitution of man and his after-life engaged in by the philosophic gentlemen.

^c Ch. 22, cf. Legge (5), vol. 2, p. 59. A translation has been given in Vol. 2, p. 76 above.

^d Ch. 18, tr. Legge (5), vol. 2, pp. 4, 5; Lin Yü-Thang (1), p. 180. There is also a similar passage on the death of Lao Tzu, ch. 3, tr. Feng Yu-Lan (5), p. 70; we gave this too in Vol. 2, p. 64 above.

^e Ancient Egyptian ideas come readily to mind, and it seems that a number of African peoples even now visualise a 'shade' soul that stays on or in the earth, and a light one that goes up into the sky (cf. Taylor (1), pp. 60ff.). As to why the dual souls in China tended to become multiple, see the discussion of Granet (5), pp. 399ff.

^f There seems to be no mention of the plurality of *hun* and *pho* souls either in the *Thai Phing Ching* (c. +150) or in the *Huang Thing Wai Ching Yü Ching* (+2nd or +3rd; cf. pt. 5); but the system does appear in the *Huang Thing Nei Ching Yü Ching* (+4th to +6th centuries). We are grateful to Mr Michel Strickmann for discussions on this subject.

^g Each one came to have a particular name, as may be seen from *Tung I Pao Chien* (+1613), ch. 1, (p. 94.2), where also there is a discussion of their relations with the organs and the emotions. See also *Huang Ti Nei Ching Su Wen I Phien*, p. 35a, b (comm.), a text which must be earlier than +1099 and perhaps much earlier.

Seven inlets or openings were classical (the *chhi khung*¹ or *chhi chhiao*,² ears, eyes, mouth and nostrils), and there were also seven emotions (*chhi chhing*,³ joy, anger, grief, fear, love, hate and desire). The origin of the three *hun* is a little less evident, but they may have been connected with the three major objectives of action (*san kang*,⁴ relationships of emperor-subject, father-son and husband-wife), and the three corresponding forms of obedience (*san shun*⁵). However this may be, the number ten, made up of seven and three,^a had crystallised for good well before the time of Ko Hung, who has several references to them in the *Pao Phu Tzu* book (c. +300).

All men, wise or foolish, know [he says] that their bodies contain *hun* souls and *pho* souls. When some of them quit the body, illness ensues; when they all leave him, a man dies. In the former case, the magician-technicians have formulae for restraining them; in the latter, the Rites provide ceremonials for summoning them back. These (souls) are of all things the most intimately bound up with us, but throughout our lives probably no one ever actually hears or sees them. But would anyone want to conclude that they do not exist because they are neither seen nor heard?^b

And he goes off into an enumeration of many famous stories of ghosts, all in order to prove that the holy immortals also exist, even though rarely seen. The reference to the Rites here indicates the *I Li* (Personal Conduct Ritual),^c similar in date to the *Li Chi* but stabilised rather earlier, and reminds us that two of the most famous odes in the *Chhu Tzhu* have the same aim. *Chao Hun*⁶ (The Summons of the Soul) dates from the neighbourhood of -240, written perhaps by Ching Chhai⁷,^d while *Ta Chao*⁸ (The Great Summons) is from nearer +205 and by a poet whose name has not come down to us.^e In both adjurations the absent soul (or souls) is recalled by the recital of all the dignities and pleasures which it has left behind—the noble palaces, the delicious food, the beautiful dancing-girls and so on.

Another mention by Ko Hung has alchemical significance.^f

The lesser elixirs for recalling *hun* souls (*chao hun hsiao tan*⁹), the pills (for countering) the three messenger-corpses,^g and the very minor medicines (made from) the five gems and the eight minerals, may sometimes melt hard ice instantly, or keep one afloat in water. They can certainly intercept ghosts and spirits, ward off tigers and leopards, and disperse congestions in the intestines and viscera. They will also dislodge the two lackeys of illness from the chest

^a The reader may like to ponder the parallel of the nine components of body, soul and spirit in ancient Egyptian tradition—see the classical exposition of Budge (4).

^b Ch. 2, p. 10a, tr. Ware (5), pp. 49-50, mod. auct.

^c Ch. 12, p. 1a, b (p. 160), tr. Steele (1); cf. *Li Chi*, *passim*, e.g. ch. 19, p. 2a, tr. Legge (7), vol. 2, p. 174.

^d Tr. Hawkes (1), p. 101, who guesses that it was composed for Prince Khao Lieh¹⁰ of Chhu (r. -262 to -238).

^e Tr. Hawkes (1), p. 109, who suggests that the person recalled from coma was Hsin, Prince Huai of Chhu,¹¹ called the 'Righteous Emperor' (I T'i¹²), r. -206 to -205, a puppet prince in the interregnum between the Chhin and Han dynasties.

^f *PPT/NP*, ch. 5, p. 3b, tr. Ware (5), p. 102, mod. auct.

^g On this doctrine see Maspero (13), p. 99.

¹ 七孔

² 七竅

³ 七情

⁴ 三綱

⁵ 三順

⁶ 招魂

⁷ 景差

⁸ 大招

⁹ 召魂小丹

¹⁰ 考烈

¹¹ 楚懷王心

¹² 義帝

and diaphragm,^a raise up those who have just died, and return frightened *hun* souls to the body that they have left. All these are common everyday drugs. If all these can indeed restore the dead to life, why should not the great medicines be able to make living men immortal?

If in the +3rd century one did not have a very sophisticated definition of death, the smelling-salts of our Victorian grandmothers,^b to say nothing of caffeine injections, might well have been called 'lesser elixirs for recalling *hun* souls'. The pharmacological argument here is particularly interesting because we often meet with it at this time in various forms. For example, Chang Hua, in his *Po Wu Chih* (c. +280), reported the following fragment from some earlier Taoist or medical source:^c

Huang Ti asked Thien Lao^d, saying: 'Of all the things that heaven and earth have brought into existence, are there some that will give a man immortality if he eats them?'

Thien Lao replied: 'There is a Thai Yang herb called *huang-ching*,^e which if one eats of it gives perpetual life (*chhang shêng*).^f There is also a Thai Yin herb called *kou-wên*,^g which one must not eat of, for if taken into the mouth it will poison and kill.^h People believe that *kou-wên* will kill men, but they do not believe that *huang-ching* is beneficial for longevity. Yet why should one be doubted and the other believed?'^g

Sceptics might have answered that a powerful poison will show its effects quickly, while it would be difficult to follow up the effects of a medicine of longevity or immortality. But the logic of these ancient chemical pharmacists was cogent in its way.

In another place, Ko Hung gives the actual numbers seven and three.^h He tells us that

my teacher also used to say that if one wished for perpetual life (*chhang shêng*)ⁱ one should diligently take the great medicines, and that if one desired to communicate with the gods and spirits one should use solutions of metals (*chin shui*)^j and practise the multiplication of one's person (*fên hsing*)^k.^l By multiplying the person one will be able automatically to see the three *hun* souls and the seven *pho* souls within one's body. One will also be able to enter the presence of the powers and principalities of the heavens, and the deities of earth, as well as having the spirits of all the mountains and rivers in one's service.

^a The reference is to *Tso Chuan*, Duke Chhêng, 10th year, i.e. -580 (cf. Couvreur (1), vol. 2, p. 85), where the same words are used in the account of the consultation of I Huan⁷ the physician on the Prince of Chin.

^b A sponge soaked with *aqua ammoniac* ('spirits of hartshorn'), together with ammonium carbonate and various perfumes, was placed in a glass-stoppered bottle (Hiscox (1), pp. 510, 628). Sometimes camphor was also used.

^c Ch. 5, p. 3b, tr. auct.

^d Presumably fictitious.

^e *Huang-ching* was certainly a *Polygonatum* related to Solomon's Seal, probably *P. chinense* = *falcatum*, or the 'mountain' species *P. lasianthum* (CC1871). The roots were eaten by Taoists, and the leaves of this liliaceous plant were thought to have much resemblance to those of *kou-wên* (B III 7).

^f *Kou-wên* was almost certainly *Rhus toxicodendron* of the Anacardiaceae (CC842) = *R. vulgaris*. Cf. B III 162.

^g On Thai Yang and Thai Yin cf. Vol. 5, pt. 4.

^h *PPT/NP*, ch. 18, p. 4a, tr. Ware (5), p. 306, mod. auct.

ⁱ Or of course 'potable gold', on which see pp. 14, 68-9, 107, 271; or, less obviously, 'metallous fluid', on which see our *nei tan* discussion, Vol. 5, pt. 5. If one takes it at its face value, the subsection on the solution of mineral salts is relevant, Vol. 5, pt. 4.

^j As the preceding paragraphs of Ko Hung's text explain, this was a technique of meditation associated with the multiplication of images of the person by means of mirrors; cf. Vol. 4, pt. 1, pp. 91-2.

^k 天老

^l 黃精

^m 長生

ⁿ 鉤吻

^o 金水

^p 分形

^q 醫緩

魂 魄 固

陽神目鬼
陰神目鬼
鬼之與魄
互為室宅

生謂之精氣
死謂之魂魄
天地公共底
謂之鬼神也

魂者氣之神有清有濁口鼻之所
以呼吸者呼為陽伸吸為陰屈也
魄者精之神有虛有實耳目之所
以視聽者視為陽明聽為陰靈也



Fig. 1306. The three *hun* 'souls' and the seven *po* 'souls' of an individual human person, in plenary session. From the *Hsing Ming Kuei Chih* (+1615), ch. 1, p. 326.

No more need be said, but in order to illustrate how concrete the imagination of the seven and the three became we give in Fig. 1306 the picture from the late Ming work on physiological alchemy, *Hsing Ming Kuei Chih* (cf. pt. 5 below), which shows the souls in full committee, as it were, on the banks of the stream of existence.^a

The real significance of all this has been already mentioned at a much earlier stage, when we were discussing Taoist material immortality in relation to organic philosophy.^b In one of his most convincing passages (there given in translation), Maspero showed^c that without some form of bodily persistence, however etherealised, it was not possible for the Yin and Yang souls to be kept together; they were bound to disperse both upwards and downwards. There was so little atomism in ancient Chinese thought^d that the *hun* and *pho* souls must have been thought of as dissolving in the ocean of *chhi*, and when later individual men and women were conceived and came to birth other cupfuls of the ocean would animate them. In accord with the character of all Chinese thought, the human organism was an organism, neither purely spiritual in nature nor purely material. It was not a *machina* with a single *deus* in it, which could go off and survive somewhere else; and for any recognisable continuance of identity its parts were not separable. If it was going to go on at all, it would have to go on as such. One could almost think of the body as the thread of a necklace on which the souls were strung. This is why Taoist immortality inescapably involved elements of materiality, and it had to be a continuance within this world (including the stars), since no other, purely 'spiritual', was conceivable. That there really were techniques of power by which the human organism could be made to do this is the belief to which we must now turn. But before doing so, we should pause for a moment to take one more look at ancient Chinese ideas of materiality and spirituality, and of being and non-being.

A few pages above we had occasion to say of the *hun* and *pho* souls that the line drawn between spirit and matter in all characteristic Chinese thinking was extremely vague. But perhaps this is only what it seems to occidental minds. We lack a thorough understanding of Chinese epistemology, and we still cannot readily say what 'matter', 'spirit', and 'nothing' meant to a Chinese thinker of antiquity or the Middle Ages.^e In Western pre-Socratic thought one of the first steps was Parmenides' assertion against the Pythagoreans that something or 'being' could not be created out of nothing or 'non-being', whatever the myths might say. The Greek atoms were islands of being in an ocean of non-being; but atomism never had any success in China,^f and the

^a How the *hun* and *pho* souls were thought of in the Thang has been the subject of a monograph by Steininger (1) devoted to the archaising *Kuan Yin Tzu* book, presumably of the +8th century but perhaps a little later.

^b See Vol. 2, pp. 153-4.

^c (13), p. 17.

^d See Vol. 4, pt. 1, pp. 3 ff.

^e In the writing of this paragraph I have been much assisted by the discussion at the Bellagio Conference on Taoism (1968) of the paper by Link (1) on the Taoist antecedents of the Buddhist-Prajña ontology of Tao-An¹ (+312 to +385).

^f Cf. Vol. 4, pt. 1, *loc. cit.*

¹ 道安

Chinese 'nothingness' (*wu*¹) was never at all the same, for any of the schools, as the Greek 'nothing' or non-being. The problem never came up in Chinese philosophy, presumably because no Chinese document had ever said that things had been produced out of nothing; therefore it did not have to be refuted. What kept *wu*¹ from being 'nothing' in the Western sense was that it was never absolute nothing, for a Creator of being or substance to work on, but rather an undifferentiated nothing which contained within itself a universal potentiality for the differentiation and appearance of everything.^a This is why the common expression *tsao hua ché*² (or *tsao wu ché*³)^b should never be translated as the Creator or Author of Change, or Things, but rather as the Immanent Shaping Force, or Nisus of Differentiation and Individuation. *Wu*¹ 'nothing', therefore, was latency or potentiality, and stood to *yu*,⁴ existing 'things', in the relation of the root (*pén*⁵) to the branches of the tree (*mo*⁶). It was also more perfect than existence because it contained so many unrealised potentialities, and many that never would be realised. The Taoists and the Buddho-Taoist syncretists would have gone some way with Aristotle's answer to Parmenides: 'creatio non ex nihilo sed ab aeterno'—Creation was not out of nothing but from eternity. It is always going on. If then one can say that there was a complete continuity, in the Chinese philosophical outlook, between 'something' and 'nothing', 'solidity' and 'emptiness', why should one be surprised that there was also continuity between 'matter' and 'spirit'? *Chhi*,⁷ one could say, was on the borderline. Only by realising these conceptions of unity and continuity can one hope to gain some idea of what the 'material' or 'physical' immortality discussed in this sub-section can have meant to the old Chinese thinkers. In the light of what we know today, or think we know, about gases, vacua, elementary physical particles, nuclear plasma, matter and energy, anti-matter, and the space-time continuum, one would hardly like to say that the ancient and medieval Chinese were any further off the mark than the ancient and medieval Europeans.^c

(iv) *Material immortality; the hsien and the celestial bureaucracy*

The idea of physical immortality originated almost imperceptibly out of the idea of longevity.^d The ancient Chinese were a very this-worldly people, full of the love of life

^a On all these questions Graham (5) is indispensable. We shall return to them in Sect. 49 in Vol. 7

^b Cf. Vol. 2, p. 564, Vol. 3, p. 599; and pp. 208-9 below.

^c We have been speaking here of the 'characteristically Chinese', but obviously it is impossible within the space of a single paragraph to do justice to the subtleties of many centuries and many schools of Chinese philosophy. What is said here must be taken only as the merest averaging of a great variety of different formulations.

^d Any person who attained great age (*lao*⁸) must necessarily have accumulated a wealth of *mana* or *charisma* (*té*⁹). As this had happened slowly the process might reasonably go on for ever, or at least far beyond the natural span, the person changing slowly (*pén*¹⁰) but not being subject to any crisis of change (*hua*¹¹). So deathlessness (*pu ssu*¹²) was a real continuation of life, and the ancient saying *Shêng jen pien erh pu hua*,¹³ 'The sage evolves but undergoes no sudden change' (cf. Vol. 2, p. 75) had a very apposite

¹ 無

² 造化者

³ 造物者

⁴ 有

⁵ 本

⁶ 末

⁷ 氣

⁸ 老

⁹ 德

¹⁰ 變

¹¹ 化

¹² 不死

¹³ 聖人變而不化

and a zest for its joys and pleasures,^a so it was quite natural that the term *shou*,¹ longevity, should have been by far the commonest term in the prayers for blessing inscribed on bronzes of the earliest Chou centuries.^b A similar preoccupation is suggested by the earlier Shang oracle-bone inscriptions.^c But gradually there grew up the idea that there might be means whereby the health and haleness of the individual could be preternaturally prolonged, or so it would seem from the abundance of bronze inscriptions from the -8th century onwards which contain such expressions as *nan lao*² (retardation of old age) or *wu ssu*³ (deathlessness).^d Even allowing for the style of the invocation poetical-courteous, as in the greeting *wan sui*⁴ (may you live for 10,000 years!), traditionally accorded during many later centuries to the emperor, these terms are unquestionably significant in the light of what follows. For from about -400 onwards, beginning in the north-eastern coastal States of Chhi and Yen but spreading through all the Chinese oikumene by the time of the first formation of the united empire in -221, the conviction crystallised that there were many men who had liberated themselves from death, and were continuing in perpetual life. They had not gone down as shades to the Yellow Springs, nor had their souls been dissipated into the vastnesses of air and earth, on the contrary these were still kept together by a perfected levitant aerostatic subtle body, permitting them to wander at will over the earth or among the clouds and stars for ever. This became a fixed belief in Chhin and Han times, taken immensely seriously by emperor after emperor, and was incorporated into the permanent deposit of Taoist faith through all the subsequent centuries. Terms in prominent usage from the late Warring States onwards were *chhang shêng*⁵ (longevity and material immortality), *pao shên*⁶ (the preservation of the body and personality, i.e. the visible individual), *chhio lao*⁷ (refusal of old age), and *pu ssu*⁸ (deathlessness). The first and the fourth of these, as we notice from many passages translated in this Section, were particularly frequent.

One can see this by the way in which Deathless or Deathlessness was applied in the names of things or places in the literature of the time, especially writings on proto-meaning here. At the same time, some later conceptions of Taoist immortality did involve 'dying', and then departing from an empty tomb or coffin, leaving only a sword, staff or sandals behind (cf. Vol. 2, p. 141, and p. 298 below).

^a Occasionally this could take the extreme form of philosophical hedonism (*chhuan shêng*,⁹ the doctrine of wholly fulfilling the individual life), and this could erect selfish enjoyment into a universal principle of action. We mentioned Yang Chu¹⁰ of the late-4th century in Vol. 2, p. 67, but he is not too well attested because of the uncertain dating of parts of the *Lieh Tzu* book, which may be no earlier than c. +300. However, Tho Hsiao¹¹ and Wei Mou¹² (Prince Mou of Wei) whose doctrines are criticised in the *Hsün Tzu* book (ch. 6, p. 136; cf. Dubs (8), p. 78; Fêng Yu-Lan (1), p. 140) may be taken as more certain historical representatives for about the same period. Their views (outrageous to the Confucians) presupposed inevitable death which would end everything (not accepted by the Taoists). On the whole subject see the study of Kobayashi Katsuhito (1).

^b See Hsü Chung-Shu (7), pp. 15 ff.

^c Cf. Creel (2), pp. 182 ff.; Chêng Tê-Khun (9), pp. 180 ff., 218 ff.; Chhen Mêng-Chia (4).

^d Hsü Chung-Shu, *op. cit.* p. 25.

¹ 壽

² 難老

³ 毋死

⁴ 萬歲

⁵ 長生

⁶ 保身

⁷ 卻老

⁸ 不死

⁹ 全生

¹⁰ 楊朱

¹¹ 它翬

¹² 魏牟

science and natural wonders. A mountain,^a a country,^b a land,^c a wilderness,^d a river,^e a people,^f a tree,^g a herb,^h and a drugⁱ—all were very attractive, if only one could get there, or find the medicine. At a later stage (in pt. 3 below) we shall read the story of the presentation of a 'drug of deathlessness', or elixir of life, to the Prince of Ching, recorded in the *Han Fei Tzu* book and therefore datable to the late — 4th century; here we may give another story of Han Fei's about a man who taught the techniques of deathlessness to a Prince of Yen. It runs as follows:

A certain travelling philosopher was once entertained at the court of the Prince of Yen (State), and taught him something of the art of immortality (*pu ssu chih tao*¹). Afterwards the prince sent some of his men to learn it (more fully), but before they could complete their studies the philosopher died. The prince, extremely annoyed, chastised the students. The prince never knew that he had been deceived by the philosopher, and censured the young men for their dilatoriness; but to believe in an unattainable thing (*pu jan chih wu*²) and then to punish unculpable emissaries, is this not a calamity of unthinkingness? Besides, any man will have a care first and foremost for his own preservation, and if (the philosopher) was not able to make himself deathless (*wu ssu*³), how could he possibly have made the prince live for ever (*chhang shêng*⁴)?⁵

Here we find the usual mixture of scepticism and sophistic argument, but what interests us is the fact that around — 320 there were men prepared to teach the art of achieving material immortality, and educated patricians who were eager to listen to them. The philosopher's art doubtless included much of what we shall later describe as 'physiological alchemy' (in pt. 5 below) with its various forms of bodily training, but it almost certainly included the ingestion of medicines. First as a *tshao*,⁵ or drug-plant, then as a *yao*,⁶ which could be either vegetable or mineral-chemical, this medicine occupied the centre of the stage from the early — 4th century onwards.

Besides the terms for material immortality already mentioned there were a number of others, some of which take us further. For example: *tu shih*⁷ (transcending the world), *têng hsia*⁸ (ascending to a distant place), *hsia chü*⁹ (dwelling therein), *chhêng hsien*¹⁰ (succeeding in becoming an immortal), *shêng hsien*¹¹ and *shang hsien*¹² (rising

^a *Pu ssu chih shan*,¹³ *Shan Hai Ching*, ch. 18, p. 2b.

^b *Pu ssu chih kuo*,¹⁴ *SHC*, ch. 15, p. 4b.

^c *Pu ssu chih hsia*,¹⁵ *Lü shih Chhun Chhiu* (— 239), ch. 135 (vol. 2, p. 133). Also in the *Yuan Yu* ode (c. — 110, cf. p. 98 below), *Chhu Tzhu Pu Chu*, ch. 5, p. 4b, cf. Hawkes (1), p. 83.

^d *Pu ssu chih yeh*,¹⁶ *Huai Nan Tzu*, ch. 5, p. 17a.

^e *Pu ssu chih shui*,¹⁷ *HNT*, ch. 4, p. 3a.

^f *Pu ssu chih min*,¹⁸ *SHC*, ch. 6, p. 3b, *HNT*, ch. 4, p. 8b.

^g *Pu ssu chih shu*,¹⁹ *SHC*, ch. 11, p. 5b, *HNT*, ch. 4, p. 2b.

^h *Pu ssu chih tshao*,²⁰ *HNT*, ch. 4, p. 5b and often elsewhere.

ⁱ *Pu ssu chih yao*,²¹ *SHC*, ch. 11, p. 5b; *Shih Chi*, ch. 28, p. 11a; *Chhien Han Shu*, ch. 25A, p. 13a; *Han Fei Tzu*, ch. 22, pp. 5b ff.

¹ *HFT*, ch. 32, p. 3a, tr. auct., adjuv. Liao Wên-Kuei (1), vol. 2, p. 39. The story was often retold afterwards, as in Chungchhang Thung's *Chhang Yen* (c. + 200), *CSHK* (Hou Han sect.), ch. 89, p. 8b; *PPT/NP*, ch. 5, pp. 6b, 7a.

¹ 不死之道

⁶ 藥

¹¹ 昇仙

¹⁵ 不死之鄉

¹⁹ 不死之樹

² 不然之物

⁷ 度世

¹² 上仙

¹⁶ 不死之野

²⁰ 不死之草

³ 無死

⁸ 登遐

¹³ 不死之山

¹⁷ 不死之水

²¹ 不死之藥

⁴ 長生

⁹ 遐居

¹⁴ 不死之國

¹⁸ 不死之民

⁵ 草

¹⁰ 成仙

up as an immortal). What means this technical term, *hsien*,¹ originally written *hsien*,² and occasionally *hsien*,³ in its simplest form showing a man and a mountain together? 'Aged but not dying,' says the *Shih Ming* dictionary (+100),^c 'they have removed (*hsien*) their habitation into the mountains'—'they have all gone into the world of light...' The most ancient meaning of *hsien* was a drunken dancing and capering,^d in which sense we find it in the *Shih Ching* (Book of Odes) c. —8th century.^e This comes again in the *Chuang Tzu* book, where one Yün Chiang⁵ is talking to an immortal, Hung Mêng,⁶ who teaches *wu wei* (not going against the grain of Nature). The latter despairs of him, and leaves, saying, 'Ah, you will only injure things. I will depart in my dancing, hovering way'.^f There is a mention of *hsien* in its later sense of *hsien*,¹ an immortal, elsewhere in the book, which would date the use to c. —300, but this is generally considered a later interpolation;^g and there are two mentions in the *Lieh Tzu*, but that cannot be exactly dated.^h It is very hard to pin-point the first textual or colloquial use of the word *hsien* in its important sense, because Han passages often refer back to earlier times. Thus both the *Shih Chi*¹ and the *Chhien Han Shu* (c. —100 and +100 respectively) record the assiduous searches which the first emperor Chhin Shih Huang Ti caused to be made in —219, very soon after he had unified the empire, for Hsienmên Kao⁷ and other *hsien* immortals.^k Similarly, the former history records the achievements of the magician-technician Luan Ta⁸ (see pt. 3 below) in Han Wu

^a *Hsien*⁹ still means to rise up and soar like a bird. Its oldest form was *hsien*,¹⁰ possibly derived from an archaic pictograph of a body with wings.

^b This is evidently related to *hsien*,¹⁰ and also to another ancient word, *phiao*,¹¹ which meant 'flying fire'. One could thus think of the immortal as a kind of 'will o' the wisp'.

^c Ch. 10, (p. 148).

^d Cf. Vol. 2, p. 134.

^e Mao no. 220, a very amusing song about the demure deportment of the guests at the outset of an archery feast, with a certain degeneration at a later stage. Tr. Legge (8), vol. 2, p. 398; Karlgren (14), p. 174; Waley (1), p. 296.

^f Ch. 11, tr. Legge (5), vol. 1, p. 302. As we have just seen, the etymological roots of the oldest words for *hsien* have to do with various kinds of flying, and this must be related to the classically established trance flights of that north-eastern continental shamanism from which the most ancient Taoism was partly derived (cf. Vol. 2, pp. 132 ff., 141; Vol. 4, pt. 2, pp. 568–9). Hence the portrayal of the immortals as feathered and winged, transformed as it were into human birds (strangely, if superficially, analogous to the angels of Christian iconography), no longer earth-bound, and able to 'take off' at will. A country of deathless feathered people was talked about in the mid —2nd century (*Shan Hai Ching*, ch. 15, p. 3 a; *Huai Nan Tzu*, ch. 4, p. 3 a; *Yuan Yu*, in *Chhu Tzu Pu Chu*, ch. 5, p. 4 b); and in later times it became customary for centuries to speak of Taoists as *yü kho*¹² (feathered guests). All this has relevance to the fact that the immortals were thought to have the freedom of the sky and the constellations as well as that of the most beautiful parts of the earth. On the whole subject see Sun Tso-Yün (1) and Chêng Tê-Khun (7).

^g Ch. 12, tr. Legge (5), vol. 1, p. 314. Of course there are many descriptions in the *Chuang Tzu* book of people or immortals to whom the word *hsien* would have been perfectly applicable, e.g. the numinous men of Ku-shê Shan in ch. 1 (cf. the translated passage in pt. 3 below), or Nü Yü and Puliang I in ch. 6 or Kuang Chhêng Tzu in ch. 11. It is just that the word itself does not appear.

^h Ch. 2, p. 3 b and ch. 5, p. 5 a. In both cases the *hsien* are coupled with *shêng*,¹³ sages as advisers of legendary emperors.

ⁱ Ch. 28, p. 10 a.

^j Ch. 25 A, pp. 9 b, 10 b.

^k Cf. Vol. 2, pp. 133–4, 240.

¹ 仙

² 僊

³ 僊

⁴ 遷

⁵ 雲將

⁶ 鴻蒙

⁷ 羨門高

⁸ 樂大

⁹ 嵒

¹⁰ 興

¹¹ 熒

¹² 羽客

¹³ 聖

Ti's time, and says that in -113, after Luan Ta had received six seals of high office in as many months, 'along the coast in the country of Yen and Chhi there was not a single (adept) who did not strike his fist on his palm and boast of possessing secret techniques for becoming one of the holy immortals'.^a And the latter history, recounting the affairs of the court of Huai Nan, tells how the prince Liu An¹ (cf. pt. 3 below) was surrounded by adepts who talked incessantly of 'the holy immortals and the art of the yellow and the white (alchemy)'.^b This means about -140. But the most important retrospective statement, perhaps, is that contained in both these histories^c saying that the whole movement began in the neighbourhood of -380. From the time of the Princes of Chhi named Wei and Hsüan,^d it is said (cf. the translation in pt. 3 below), Tsou Yen² (-350 to -270)^e and his followers in the School of Naturalists made a great stir with their theories about the world of phenomena,^f while many investigators sought out ways of converting longevity into material immortality.^g Furthermore, from the time of Prince Chao of Yen,^h many expeditions were sent out into the Eastern Ocean to search for the islands of Phêng-Lai where the drug of deathlessness, the medicine of immortality, could be found.ⁱ Consequently in spite of the absence of the word *hsien* from most pre-Han texts,^j it certainly must have been known and used, doubtless in restricted circles, very likely only in the north-eastern States, from soon after -400 onwards. What made the fortune of the proto-scientific quasi-magical quasi-religious movement of those parts was the unification of the empire after -225, for the Chhin imperial court needed a mystique and found it in the ideas of the Naturalists and Taoists.^k It was destined to continue long.^l

Nor was it a matter only of restricted court cult-rituals or illiterate folk-religion; the greatest poets of the age wrote odes and lyrics about the gods and the holy immortals

^a SC, ch. 28, p. 28b, cf. Chavannes (1), vol. 3, p. 482.

^b CHS, ch. 44, p. 8b. The bibliographical chapter also mentions *hsien* (ch. 30, p. 53a), but it probably dates from the turn of the era, around Wang Mang's time.

^c SC, ch. 28, pp. 106ff.; CHS, ch. 25A, pp. 12aff.

^d These two reigns have usually been placed from -377 to -312, but some scholars prefer the dates -358 to -320 for Wei and -319 to -301 for Hsüan.

^e Some prefer the dates -305 to -240, but these seem rather too late.

^f See Vol. 2, pp. 232ff.

^g Cf. Vol. 2, p. 240. Cf. p. 13 above.

^h A reign from -311 to -278 is generally accepted.

ⁱ Chhin Shih Huang Ti engaged massively in this from -219 onwards, as we know from *Shih Chi*, ch. 6, p. 18a, where the word *hsien* appears for the immortal beings who lived upon the islands, and whose help was sought.

^j It does not occur in *Shan Hai Ching* (where one would expect it), *Lun Yü*, *Mêng Tzu*, *Li Chi*, *Hsün Tzu*, *Mo Tzu*, *Lü shih Chhün Chhiu*, nor in the *I Ching*, nor even in the *Huai Nan Tzu*. By the +1st century it is of course commonplace, as witness Pan Ku's *Hsi Tu Fu* (*Wên Hsüan*, ch. 1, p. 6b) and Wang Chhung's *Lun Hêng*, ch. 24 especially (cf. Forke (4), vol. 1, p. 336). Both these texts belong to about +80. Cf. *Shuo Wên* (+121), ch. 8A, (p. 167.2). But already by about -100, in the *Shih Chi*, there are as many as 24 mentions. And one finds it in the *Yuan Yu* ode (c. -110, *Chhu Tzhu Pu Chu*, ch. 5, p. 2a), and an early example of *chen jen*,³ 'the perfected ones', too.

^k It is interesting that the word *hsien* is never found in early bronze inscriptions, but suddenly becomes quite popular after about -130, especially on mirrors. Some 17 of these inscriptions have been recorded by Jung Kêng (3), Hou phien, pp. 26ff., and some of them have been translated by Karlgren (18).

^l On the history of the cult of the Holy Immortals in general there are recent books of value by Chou Shao-Hsien (1) and Murakami Yoshimi (3).

of Taoism. This was particularly true of the style called after the former State of Chhu. Long before the unification of the empire, at some time about -300, an aristocratic scholar of Chhu had written the famous ode called *Li Sao*¹ (On Encountering Sorrow).^a Chhū Yuan's² poem begins as a lament for the evils of the human world, slanderous misrepresentation and royal folly, but he images himself as a magician, journeying away from it in an airborne chariot to a western paradise, commanding the deities, and paying court to numerous goddesses, unsuccessfully, on the way. But somehow the poet's magic is not strong enough, and as he returns to hover over his old home he ends in complete despair, disillusioned alike with the world of men and with the supramundane world through which he has been travelling. Another ode, *Yuan Yu*³ (Roaming the Universe; or, Journey into Remoteness), written by an unknown poet about -110, might be regarded as a Taoist's answer to the *Li Sao*; for it describes a celestial journey which ends not in gloom and disappointment but in an ecstatic oneness with the Tao of all things.^b As Yü Ying-Shih says, the *Yuan Yu* ode is one of the finest ancient descriptions we have of how the life of the perfected immortal might be visualised.^c This is the point at which we ought to take a look at it.

It opens with a similar statement of the evils and afflictions of the human world, but the poet tells how he found serenity in emptiness and silence, gaining true satisfaction from the ways of Nature and not doing what was contrary to them. He heard how the Red Pine Master (Chhīh Sung Tzu⁴) had washed off the world's dust, and he honoured the wonderful powers of the Perfected Ones (*chen jen*⁵), admiring those who in old times had become *hsien*.⁶ 'They departed from the flux of change and vanished from men's sight', they escaped unafraid from all life's troubles, and no one could tell whither they had gone. So he set off on his marvellous journey.

Spring and autumn hurried by, never delaying;
How could I always stay in my old home?
Hsien Yuan^d was too remote for me to aspire to;
I would follow Wang Chhiao^e for my delight.

^a The usually accepted date is about -295, but some scholars such as Chiang Thien-Shu (1) make it as late as -269, not long before his death in -262.

^b These descriptions are based upon the words of Hawkes (1), introducing his excellent translations of both poems. He sees in them shamanist trance spirit-journeys.

^c (2), p. 91, in a learned study of the ideas of immortality in ancient China which we have gratefully drawn upon in the writing of these paragraphs. We only regret that we cannot in any way follow him in his distinction between 'this-worldly' and 'other-worldly' immortality. If one bears in mind the conceptions of different peoples (Indo-Iranian, Christian, Islamic, etc.) there was no such thing as an 'other world' in ancient Chinese thought at all—that is why it is often so refreshing. There was no heaven or hell, no creator God, and no expected end of the universe once it had emerged from primeval chaos. All was natural, and within Nature. Of course, after the permeation of Buddhism, 'the case was altered'.

^d I.e. Huang Ti, the Yellow Emperor, legendary personage adopted as the patron saint of all Taoists.

^e I.e. Wangtzu Chhiao,⁷ a historical prince, son of the High King Ling of Chou (r. -571 to 545), and afterwards adopted by the Taoists as one of their heroes. His name was attached to a set of gymnastic exercises (cf. pt. 5 below), and he appears in sailors' litanies of the magnetic compass (Vol. 4, pt. 1, p. 286). Cf. pp. 101, 111 below and Fig. 1307. Here he is consulted on physiological alchemy.

¹ 離騷

² 屈原

³ 遠遊

⁴ 赤松子

⁵ 真人

⁶ 仙

⁷ 王子喬



Fig. 1307. The legendary immortal Wangtzu Chhiao, playing the *shêng* while riding through the clouds on a crane (*Lieh Hsien Chhüan Chuan*, ch. 1, p. 27b).

I supped the Six *Chhi*; drank the Night Dew;^a
 Rinsed my mouth in the Sun Mist; savoured the Morning Brightness;^b
 Conserving the pure fluid of the spiritual light;
 Absorbing the *chhi* of the *ching* and rejecting the grosser part.^c
 Drifting in the wake of the gentle south wind,^d
 I travelled to Nan-chhao in a single journey.
 There I saw Master Wang and made him salutation,
 And asked him about the union of the *chhi* (of the primary vitalities).^e
 He said:

'The Tao can only be received, it cannot be given.
 So small that it contains nothing, so great that it has no bounds.^f
 Keep your *hun* soul from confusion, and it will come of itself (*tsu-jan*).^g
 Unify the *chhi* and control the spirit (*shen*),^h
 Preserve them within you at the midnight hour,
 Await it in emptiness, before even Inaction.^g
 All categories of things are brought into being by this;
 This is the Door of Power (*tê chih mên*).^h

Having heard this precious teaching, I departed,
 And swiftly prepared to start on my journey.
 I met the Feathered Ones (*yü jen*)ⁱ at Cinnabar Hill,ⁱ
 I tarried in the ancient Land of Deathlessness (*pu ssu chih chiu hsiang*).^j
 In the morning I washed my hair in the Hot Springs of Sunrise,
 In the evening I dried myself where the ten suns perch.^j
 I sipped the subtle potion (*wei i*)^k of the Flying Springs,^k
 And held in my bosom the radiant metallous jade.^l
 My pallid countenance flushed with brilliant colour,
 Purified, my *ching* of vitality began to grow stronger;

^a This is a reference to respiratory exercises, the swallowing of saliva, and abstention from cereal foods.

^b A reference to the phototherapeutic practices (Vol. 5, pt. 5) and the ingestion of cosmic *chhi*.

^c Perhaps a reference to *coitus thesauratus* (cf. pt. 5); surely also to the circulation of the *chhi* (also discussed in pt. 5), 'breathing out the old and breathing in the new'.

^d Cf. Lieh Tzu, in Vol. 2, p. 66, Vol. 4, pt. 2, pp. 568ff.

^e On the primary vitalities, *chhi*, *ching* and *shen*, see below in pt. 5. On the union of the *chhi* of male and female see Vol. 2, p. 150.

^f An echo of the *Tao Tê Ching*'s paradoxes; see e.g. chs. 14, 25, 34, 41 (Waley (4), pp. 159, 174, 185, 193 respectively).

^g I.e. avoidance of all action contrary to Nature; cf. Vol. 2, pp. 68ff.

^h Virtue or *mana* in the actions of the sage or the immortal, who aligns himself with the *nisus formativus* of differentiation, individuation and life, inherent in the natural universe. See Vol. 2, p. 35.

ⁱ An obvious reference to alchemical elixirs.

^j This is the tree of the sun and the moon, a mythical theme common both to Chinese and Western imaginations; see Vol. 3, Fig. 242 and *passim*. One was supposed to grow on each of two islands situated at the extreme east and west of the earth. The ten suns of the ten-day 'week', or decade of days, rested there until it was time to take off on their scheduled flights.

^k A clear reference to alchemical elixirs, especially as *fei*, flying, was the technical term for sublimation and distillation (cf. pt. 4 below). One would hardly like to rule out the possibility that the whole vision described was a product of the delirium caused by mineral drugs or hallucinogenic plants.

^l The expression in the text is 'radiant *wan-yen*' jewel', but the commentaries make it clear that the reference is to the swallowing of saliva, the 'metallous wine' or 'jade juice', on which see pt. 5 below.

¹ 自然

² 神

³ 德之門

⁴ 羽人

⁵ 不死之靈藥

⁶ 靈液

⁷ 瓊瑤

My corporeal parts dissolved to a soft suppleness,
 And my spirit grew lissome and eager for movement.
 How fine was the fiery nature of the southland!
 How lovely the winter blooming of the cassia!^a

Thus in veiled words the poet recounts his instruction in Taoist philosophy and his practice of many of the Taoist exercises in physiological alchemy.^b Without all these he could never have dared to envisage his entry into the world of the holy immortals. Then a moment later, he is off.

Restraining my restless *pho* soul I mounted the empyrean,^c
 I clung to a floating cloud and rode aloft on it.
 I bade the gate-guard of the heavens open his doors,
 And he pushed back the portals and looked out at me;
 I summoned Fêng Lung¹ to lead the way ahead,^d
 And asked for the Grand Forbidden Enclosure;^e
 I reached the very spheres of the storied heavens,^f
 And entered the court of the Ruler Above (*ju Ti kung*);^g
 I came to the Computer of the Decades of Days (*hsün shih*),^h
 And viewed the Pure City, hub of all that there is,ⁱ
 In the morning I set out from the court of the heavens,
 In the evening Wei-Lü⁴ came in sight below.^j
 I marshalled together my ten thousand chariots;

^a Tr. Hawkes (1), pp. 83-4, mod. auct. *Chhu Tzhu Pu Chu*, ch. 5, pp. 3b-5a.

^b On these see Vol. 5, pt. 5 below at length. It is noteworthy that Wangtzu Chhiao is depicted as still inhabiting, though an immortal, a place on the earth. A cave near Chhao-hsien in Anhui was sacred to him. Perhaps he too, after the experience of absorption into the Tao, chose to return to haunt a particular place here below.

^c From what we have seen (p. 87 above) of the gravitational propensities of *pho* souls this would obviously be necessary.

^d A rain and cloud god.

^e There were three great enclosures in Chinese uranography. The *Tsu wei yuan*⁵ (Purple forbidden enclosure), representing the imperial palace, was essentially the North polar region, surrounded by two 'walls' of stars and extending from about 65° North to the equatorial pole; cf. Schlegel (5), pp. 508ff., 534. The *Thai wei yuan*⁶ (Grand forbidden enclosure, here alluded to), representing the imperial court and the crown prince, was a region, also with two 'walls' surrounding it, in Virgo and Leo, just above the 180° equinoctial point (where equator and ecliptic cross). It centered on R.A. 12 h., with a d. about 0 to 20 or 30° N.; cf. Schlegel (5), pp. 472, 475, 534. Thirdly, there was the *Thien shih yuan*⁷ (Celestial market-place), representing the people, a larger area in Ophiuchus, Hercules, Serpens (Caput and Cauda), and Aquila, centred on R.A. 17 h., with a d. from 15° S. to 30° N.; cf. Schlegel (5), p. 536.

^f Lit. *chung yang*,⁸ for the Yang force or *chhi* was piled up in the acme of the heavens. On the concept of nine *chung*, storeys or layers, in the heavens see Vol. 3, p. 198.

^g A Han representation of immortals paying court to the god or celestial official of the Great Bear has been given in Fig. 90 (Vol. 3, p. 241).

^h One of the names for the planet Venus (*Thai pai*⁹). On the division of days into decades, which preceded the use of the seven-day week in China, see Vol. 3, p. 397.

ⁱ The Pure City (*Chhing tu*¹⁰) is explained as equivalent to the *Tsu wei yuan* (Purple forbidden enclosure, see above), the potter's wheel (*chün*¹¹) of the heavens, round which all the stars revolve, and the home of one of the celestial emperors.

^j This may have been intended here as the name of an eastern mountain, but more probably means the terrestrial cosmic cloaca, great vortex, or maelstrom (*wei lü*¹²) east of the Eastern Ocean, into which it everlastingly pours (cf. Vol. 4, pt. 3, pp. 548-9).

¹ 豐隆

² 入帝宮

³ 旬始

⁴ 微闕

⁵ 紫微垣

⁶ 太微垣

⁷ 天市垣

⁸ 重陽

⁹ 太白

¹⁰ 清都

¹¹ 鈞

¹² 尾闕

Slowly and grandly we rode side by side,
 Mine harnessed eight dragons, coiling and curveting,
 And bore a cloud banner that flapped in the wind...^a

Thus he goes on his way, touring, as it were, the universe, visiting the gods and spirits of stars, air, earth and ocean—nor does he fail to pause and look down at his old home far below—but the poem leads on not to despair but to mystical union with the immanent Tao.^b The significant thing is that though he may be among the constellations he is still within the world of Nature, for in fact there is nothing outside this. The ode ends as follows:^c

Thereupon I left, and resumed my wandering,
 Keeping step together, we galloped far away,
 Till at the wide world's end, we came to the Gate of Cold,
 Racing the rushing wind to the Spring of Purity;
 I followed Chuan Hsü¹ over the piled-up ice,^d
 And turned aside to cross the realm of Hsüan Ming;^e
 Bestriding the Pole of Division (*chien wei*),^f I looked back behind me.^g
 Then I summoned Chhien Lei⁴ to appear before me^g
 And sent him on in front to make straight the way.
 Traversing the four dimensions,
 Roving the six directions of space,
 High in the aurora's cracks and fissures^h
 I passed, and far below, in the bottomless pit.ⁱ
 In the sheer depths, the earth above was invisible,
 In the vastness of the heights, the sky could not be seen;
 When I looked, my startled eyes saw nothing,
 When I listened, no sound met my bewildered ear.
 Thus, transcending Inaction, I attained to the (Great) Clarity,
 And entered the precincts of the Great Beginning.^j

^a Tr. Hawkes (1), p. 84, mod. auct. *Chhu Tzhu Pu Chu*, ch. 5, pp. 5b-6a.

^b It is here that we find (p. 8a) one of the earliest occurrences of the expression *tu shih*, Flanked by the gods of rain and thunder, the poet is inspired by the wish to transcend the world of men and forget about returning (*yü tu shih i wang kuei*).

^c Tr. Hawkes (1), pp. 86-7, mod. auct. *Chhu Tzhu Pu Chu*, ch. 5, pp. 9b-10b.

^d The god of the north. Often identified with Kaoyang shih,⁶ divine ancestor of the princes of Chhu, but perhaps originally a different being.

^e A spirit attendant upon Chuan Hsü.

^f *Wei* here are the four terrestrial meridians separating quarters, with a distance of 91.31° between them since the circle was always divided in Chinese cosmology into 365.25° (Vol. 3, *passim*). It may be rather interesting that the writer of the *Yuan Yu* visualised them as meeting at a terrestrial pole, for it would imply a conception of the sphericity of the earth. Many of the early Chinese cosmologists certainly did envisage this, using as analogy the round yolk within the avian egg-shell, or the roundness of a crossbow-bullet (cf. Vol. 3, pp. 217-18, 498-9).

^g A creative spirit, counterpart of Hsüan Ming.

^h This translation may be authorised by Vol. 3, p. 483.

ⁱ *Ta ho*,⁷ the 'great abyss', occurs in the *Lieh Tzu* book and *Shan Hai Ching*. As it is said to be beyond the Eastern Ocean, it is probably the same thing as the *Wei lü*.

^j *Thai Chhu*,⁸ the Undifferentiated, the Homogeneous. Cf. Vol. 2, pp. 114ff.

¹ 顯頊

² 玄冥

³ 閼緯

⁴ 黔羸

⁵ 欲度世以忘歸

⁶ 高陽氏

⁷ 太極

太初

Thus everything ends on a note of absorption into the One, but it is the real world that has been ransacked on the way, and not some other. That there is here an early Taoist equivalent of *arūpaloka* (cf. p. 81), what the Buddhists might have regarded as a *praeparatio evangelica* for their nirvana doctrine, is interesting, but not here our most important concern; what matters for us is the Taoist immortal's freedom and durability within the world of Nature. And it is clear that alchemy, both chemical and physiological, was already the price and engine of this freedom.

About -10 Ku Yung¹ addressed the emperor Chhêng Ti as follows:^a

When Chhin Shih Huang Ti first unified the empire, he was much attracted by the Tao of the holy immortals. So he sent people like Hsü Fu² and Han Chung³ to sea, with many young men and capable girls, to search for the immortals (of the islands) and to collect (their) medicines. But they all took the opportunity to run away, and none of them ever came back. Such (expensive) projects aroused the ire and resentment of all under Heaven.^b Then after the rise of the Han, men like Hsinyuan Phing⁴,^c Shao Ong⁵,^d Kungsun Chhing⁶,^e Luan Ta⁷,^f and many others from Chhi, all received honours and favours from Han Wu Ti on account of their knowledge of the alchemical metallurgy of the immortals (*hsien jen huang yeh*⁸) with its melting of yellow (gold), their skill in making sacrificial offerings, their ability in serving the ghosts and spirits, their power over natural things, and their willingness to go to sea to search for the immortals and their drugs. The presents that were bestowed on them amounted to thousands of (ounces of) gold. (Luan) Ta was especially honoured, and even married a princess. Titles and positions were heaped upon him to such an extent that all within the four seas were shocked. Thus during the Yuan-Ting and Yuan-Fêng reign-periods (-116 to -103), there were thousands of magician-technicians in the regions of Yen and Chhi who glared around and slapped their thighs, swearing that they were the real experts in the arts of achieving the life of the holy immortals, making liturgical sacrifices, and gaining blessings....

Over and over again in these pages we encounter the deep interest of emperors and the highest of their officials, to say nothing of all kinds of princes and patricians, in the attainment of material immortality;^g and as it is evident that few of them could ever afford the time, the seclusion or the patience for engaging in the physiological practices of Taoist training, the ingestion of elixirs was the obvious alternative,^h and proto-chemical alchemy was thereby greatly strengthened. It is interesting to find in the +2nd-century *Thai Phing Ching* high praise for the ethical merits of any man who devotes himself to the research for strange formulae and medicines of immortality for his prince or lord (*chün wang*).ⁱ But often this was accompanied by a third method which ought not to be forgotten, the liturgical one—prayers, sacrifices, processions,

^a *Chhien Han Shu*, ch. 25B, pp. 14bff., tr. auct. adjuv. Yü Ying-Shih (2). Also *CSHK* (Chhien Han Sect.), ch. 46, p. 7a, b. The remainder of Ku Yung's speech is translated at a later place, in pt. 3 below.

^b Cf. Vol. 4, pt. 3, pp. 551ff. for a fuller account of the voyages.

^c A geomancer from Chao, fl. -180 to -160.

^d See pt. 3 below.

^e Cf. p. 105.

^f See pt. 3 below.

^g See pp. 13, 95, 97, 121-2.

^h The history of this will be told in Sect. 45 in Vol. 6; meanwhile see Ho Ping-Yü & Needham (4), repr. in Needham (64).

ⁱ Wang Ming ed., pp. 131-3, cf. also 230.

¹ 谷永

² 徐福

³ 韓終

⁴ 新垣平

⁵ 少翁

⁶ 公孫卿

⁷ 樂大

⁸ 仙人黃冶

⁹ 君王

incantations and the like, in temples especially built for the worship of gods and the veneration of the holy immortals.^a From the beginning of the united empire this theme is apparent, and it must have been present in the proto-feudal States a good deal earlier. For example, the posthumous edict of Chhin Shih Huang Ti, forged by the eunuch Chao Kao¹ in -209, begins by saying: 'We have accomplished an imperial progress throughout the whole empire, and have offered sacrifices to the divinities of the famous mountains in the hope of prolonging Our life.'^b This must have included the celebrated *fêng*² and *shan*³ sacrifices. On the Confucian view, these had the purpose of announcing to Heaven the achievement of general peace by a new dynasty in pursuance of its mandate,^c but the Taoists regarded them as primarily for the attainment of the emperor's immortality.^d Master Ting of Chhi,⁴ an old man over ninety at the time, said precisely this when he met Han Wu Ti on his way to perform these sacrifices in -110.^e In the previous year, after the conquest of the southern State of Nan Yüeh, orders had gone to the native priests to resume those sacrifices to the dead which had proved beneficial for the longevity of earlier rulers;^f and in the year following, two great temple halls named I Yen Shou Kuan⁵ were built for the veneration of the immortals, one at the capital and the other at a place called Kan-chhüan, Sweet-water Springs, a couple of hundred *li* away to the north.^g Tiles and bricks stamped with the name of these 'Longevity-Benefiting Temples' have come to light in our own time.

It was perhaps precisely the imperial involvement which 'celestialised' the former predominantly terrestrial condition of the enduring immortals, and led indeed to the imaginative cosmism of poets like the writer of the *Yuan Yu*. We can see this process at work rather clearly in Ssuma Chhien's life of Ssuma Hsiang-Ju,⁶ the great poet and road-builder of the mid -2nd century.^h After quoting his poetical lament on the ill-fated 'second emperor' (Chhin Shih Huang Ti's son), the historian goes on:ⁱ

Han Wu Ti had earlier expressed admiration for the poet's ode on Tzu-Hsü (Mr Fantasy).^j Ssuma Hsiang-Ju, observing that the emperor was fond of anything dealing with the Tao of the immortals, took occasion to remark: 'My description of the Shang Lin (Hunting Park)^k is hardly deserving of praise, but now I have something that is finer. A good while ago I began a rhapsodical ode on the Mighty One (*Ta jen Fu*,⁷ i.e. on the emperor); it is not yet finished but as soon as it is ready I shall beg to present it to your Majesty.' Now (Ssuma

^a See further shortly, pp. 128 ff.

^b *Shih Chi*, ch. 87, p. 111b, tr. Bodde (1), p. 32.

^c Cf. Tsêng Chu-Sên (1), pp. 239 ff.

^d Cf. the discussion of Fukunaga Mitsuiji (1).

^e *Shih Chi*, ch. 28, p. 33b, tr. Chavannes (1), vol. 3, p. 497; Watson (1), vol. 2, pp. 56 ff.

^f Cf. Watson (1), vol. 2, p. 63.

^g *Shih Chi*, ch. 28, p. 37a, tr. Chavannes (1), vol. 3, p. 508; Watson (1), vol. 2, p. 63. Parallel passage in *Chhien Han Shu*, ch. 25B, p. 1b. Similar names for Taoist temples connected with the imperial court continued throughout the ages, e.g. Chhang Shêng Tien⁸ in the Tang. On Kan-chhüan cf. Vol. 4, pt. 3, pp. 9, 14.

^h Cf. Vol. 4, pt. 3, p. 25.

ⁱ *Shih Chi*, ch. 117, pp. 36a ff., 40b, tr. Watson (1), vol. 2, pp. 332-6, mod. auct.

^j *Wên Hsüan*, chs. 7, 8; tr. von Zach (6), vol. 1, pp. 103 ff.; Watson (1), vol. 2, pp. 301 ff.

^k Part of the ode just mentioned (*Tzu Hsü Fu*⁹).

¹ 趙高
司馬相如

² 封
大人賦

³ 禪
長生殿

⁴ 齊丁公
子虛賦

⁵ 益延壽觀

Hsiang-Ju had noticed that the older traditions about famous immortals generally pictured them as emaciated beings haunting the mountains and marshes, but he felt that this was not at all what princes and emperors meant when they talked about immortality. So he completed his 'Ode on the Mighty One' as follows.

[Ssuma Chhien then gives the text, and it is quite like the *Yuan Yu* already quoted, which probably copied part of it a few years later.]

When (Ssuma) Hsiang-Ju presented his ode the emperor was overcome with delight, declaring that it made him feel as if he were already whirling away over the clouds, and roaming without fatigue through all the earth and the heavens.

This was in -118 or thereabouts. In fact the prototype of all imperial flights and ascensions was the legendary emperor Huang Ti,¹ and five years afterwards one of Han Wu Ti's court adepts, Kungsun Chhing,² was telling him about this event in considerable detail. After Huang Ti had cast a bronze tripod cauldron once upon a time at Shou-shan³ (and doubtless brewed a chemical elixir in it),^a a celestial dragon vehicle came down from the heavens to fetch him, into the which he stepped—together with more than seventy other people, both ministers and palace ladies, and they all mounted up into the sky in full view of the populace.^b This was the occasion on which it is recorded that Han Wu Ti unfeelingly said: 'Ah, if I could only become like the Yellow Emperor, I can see myself leaving behind my women and their children as lightly as casting off a sandal.'^c That is worth remembering, for attitudes to others in the search for immortality were sometimes very different, and we shall return to them.^d

As was noted long ago,^e Huang Ti, though among the most ancient of the legendary emperors, was in fact among the last to be invented.^f There is no reference to him earlier than a bronze inscription of the State of Chhi dated about -375, where he appears as a remote ancestor of its prince.^g He then figures again towards the end of the same century in T'sou Yen's theory of the cyclical revolutions and transformations of the Five Powers;^h this links him closely with what came to be known as Huang-Lao⁴

^a See Ko Hung on this subject, in pt. 3 below.

^b It is sad to record that in some versions of the story certain lesser ministers held on by the hairs of the dragon's beard, but these gave way, so they were left behind. Perhaps an anti-bureaucratic embellishment.

^c *Shih Chi*, ch. 28, p. 31a, b, tr. Chavannes (1), vol. 3, pp. 488ff.; Watson (1), vol. 2, p. 52. Parallel passage in *Chhien Han Shu*, ch. 25A, p. 28a.

^d It seems quite paradoxical that Yü Ying-Shih (2), pp. 102, 105, should characterise the legends of the Huang Ti type and the corresponding celestial immortalism as 'this-worldly'; it was no more this-worldly, or 'other-worldly' either, than the terrestrial type. Neither can be properly assessed without an understanding of the subtly interwoven roles of 'asceticism', sexual techniques and Nature-mysticism in Taoist religion. Western preconceptions simply will not suffice here.

^e Vol. 1, pp. 87-8.

^f If indeed he was an invention. 'Legendary' characters in China have a habit of coming to life, as the Shang Kings did. If pottery of Lungshan and Yangshao type in Taiwan is now being radio-carbon dated to -5000 (private communication from Dr Chêng Tê-Khun), there was a lot of pre-Shang time, and there may have been a Hsia kingdom after all.

^g Hsü Chung-Shu (8).

^h Cf. Vol. 2, p. 233. Cf. Hsü Chung-Shu, *op. cit.* p. 502. The story of the ascension of Huang Ti occurs in *Chuang Tzu*, ch. 6 (tr. Feng Yu-Lan (5), p. 118; Legge (5), vol. 1, p. 244), but it is regarded as a later interpolation.

¹ 黃帝

² 公孫卿

³ 首山

⁴ 黃老

Taoism, which originated in Chhi about that time.^a Many of the scholars of the Chi-Hsia Academy there, before and after –300, were Huang-Lao Taoists.^b This was a syncretism which united the philosophers of the old *Tao Tê Ching* tradition with the cult of immortality, the alchemical techniques both proto-chemical and physiological, and the beginnings of Taoist temple liturgy. Although the details of its development are still rather obscure,^c Huang-Lao Taoism was growing and burgeoning all through the Chhin and Han periods. One of its earliest adepts was probably that Master An Chhi (An Chhi shêng¹) who was so eagerly sought for in Han Wu Ti's time.^d Presumably Huang Ti and Lao Tzu were at first venerated as *hsien*, but in the Later Han divine honours were paid to both of them, if indeed they did not fuse into a single deified being. The emperor Huan Ti (r. +147 to +167) repeatedly sent envoys to offer sacrifices at Lao Tzu's reputed birthplace, and he himself officiated at similar ceremonies in the palace. This was the time of Pien Shao's² inscription on Lao Tzu, which shows how closely the deified prophet was associated with *hsien* immortality;^e and about +170 the worship of a Huang-Lao Chün³ was patronised and propagated by Liu Chhung⁴ and other Han princes.^f Thus the ascension of some immortals into the heavens became a firmly rooted belief in Taoism, and hence in popular thought, while other immortals continued to haunt the earth as before.

Thus arose the distinction between *thien hsien*⁵ and *ti hsien*.⁶ Already in +20 Huan Than named five categories of spiritual beings.⁸ The mid +3rd-century *Thai Shang Ling-Pao Wu Fu Ching*⁷ lays great emphasis on *thien hsien* (empyrean immortals) as if to affirm their superiority. Ko Hung wrote in the *Pao Phu Tzu* book:^h

The manuals of the immortals say that masters of the highest category (*shang shih*⁸) are able to raise themselves high up into the aery void (*chü hsing shêng hsü*⁹); these are called 'celestial immortals (*thien hsien*⁵)'. Those of the second category (*chung shih*¹⁰) resort to the famous mountains (and forests) and are called 'terrestrial immortals (*ti hsien*⁶)'. As for those of the third category (*hsia shih*¹¹) they simply slough off the body after death, and they are called 'corpse-free immortals (*shih chieh hsien*¹²)'.ⁱ

^a Wên I-To (3), p. 154.

^b Kuo Mo-Jo (1), p. 160. Cf. Vol. 1, pp. 95–6; Vol. 2, p. 235.

^c There is a special study of this by Akitsuki Kanei (1).

^d See Vol. 2, p. 134, Vol. 4, pt. 1, p. 316, and Vol. 5, pt. 3. Cf. Wên I-To (3), pp. 170ff.; Chhen Phan (7), pp. 26ff.

^e CSHK (Hou Han sect.), ch. 62, pp. 3aff.

^f *Hou Han Shu*, ch. 80, p. 2b. It is of much interest that this Liu Chhung was also associated with the invention of grid sights and other sighting devices for accurate shooting with crossbows (cf. Sect. 30). We have met many other examples of similar convergence of Taoist or Neo-Confucian philosophy with scientific or technological activities, cf. Vol. 2, p. 494. On the divinisation see at length Seidel (2).

^g *Hsin Lun*, in CSHK (Hou Han sect.), ch. 15, p. 6a. First, *shen hsien*¹³ (holy immortals), second grade, *yin lun*¹⁴ (hidden absorbed ones), third, *shih kuei wu*¹⁵ (commanders of ghostly things), fourth, *hsien chih*¹⁶ (masters of foreknowledge), fifth, *chuning*¹⁷ (re-moulded perdurables). All these were terrestrial.

^h PPT/NP, ch. 2, p. 9a, tr. auct. adjuv. Ware (5), p. 47. The three categories of *shih* recall the *Tao Tê Ching*, chs. 38 and especially 41 (cf. Waley (4), pp. 189, 193).

ⁱ On *shih chieh*, cf. Vol. 2, p. 141, and Maspero (13) *sub voce*. Also particularly pp. 302ff. below.

¹ 安期生

² 邊韶

³ 黃老君

⁴ 劉寵

⁵ 天仙

⁶ 地仙

⁷ 太上靈寶五符經

⁸ 上士

⁹ 舉形昇虛

¹⁰ 中士

¹¹ 下士

¹² 尸解仙

¹³ 神仙

¹⁴ 隱淪

¹⁵ 使鬼物

¹⁶ 先知

¹⁷ 鑄凝

He does not explain where the last category went to reside, but presumably it was somewhere more agreeable than the Yellow Springs, perhaps one or other of the less famous mountains and forests.^a It seems that an adept could choose between being a celestial or a terrestrial immortal, for the *Shen Hsien Chuan*, probably of the early +4th century though Ko Hung's authorship remains doubtful, contains a particularly interesting account of a *Pai Shih hsien-sêng*¹ (Mr White-Stone), who specifically chose the latter course. It is worth reading.^b

Mr White-Stone was a disciple of Chung-Huang Chang-Jen. In the time of Phêng Tsu^c he was already over 2000 years old. He was not willing to cultivate the Tao of rising into the heavens (as an immortal) but he just wanted to be an immortal as such. He did not intend to do away with the joys and happinesses of life among men, so the course of action he adopted was to practise the arts of the bedchamber as the main thing,^d and to emphasise the taking of the medicine of potable gold (*chin i*).² In his youth he was poor, and could not buy the drugs required, indeed he lived as a shepherd and pig-keeper for more than ten years, frugal of dress and diet, but at length he acquired ten thousand pieces of gold,^e and was able to buy the great medicine and consume it. He often used to heat a certain white mineral with his food, and lived in the mountains near some white rocks, so people called him 'Mr White-Stone'. On a day when he had eaten meat and drunk some wine he could travel three or four hundred *li*, appearing to those who met him not more than forty years old. He liked temple worship and liturgies, and was fond of reading esoteric books such as the *Thai Su Chuan*.³

Phêng Tsu once asked him why he did not take the chemical which can make one rise into the heavens, to which he replied: 'Can the joys of the heavens really compare with those that are found among men? If one can go on living here below without getting old and dying, one will be treated with the greatest respect; would one be treated any better in the heavens?' So the people all said: 'Mr White-Stone is a *hsien* who wants to avoid becoming a *hsien*.' It was because he did not seek to rise into the heavens to take a place among the celestial bureaucracy (*hsien kuan*).⁴ Nor did he have any desire for fame and renown in this present world.

The charmingly democratic, almost bucolic, atmosphere of this story gives one the impression, not that the Han and Chin Taoists were 'worldly', but that some of them had well appreciated the idea of eternal life in the midst of time, and that *samsara* is *nirvana*.^f

On the other hand there was a widespread belief that certain immortals had been seen to ascend into the heavens in broad daylight. The *Hou Han Shu* itself contains a circumstantial account of a performance of this kind by an adept named Shang-chhêng Kung,⁵ witnessed by two well-known scholars of the time, Chhen Shih⁶

^a Ko Hung adds that Li Shao-Chün (cf. p. 13) went away as a *shih chieh hsien*. The *Thai Phing Ching* suggests (Wang Ming ed. p. 698) that the immortals sometimes spend long periods in the wild places of the earth before they are ready to ascend into the heavens.

^b Ch. 2, no. 1, tr. auct. Fig. 1308.

^c See Vol. 5, pt. 5 below.

^d See further in pt. 5 below.

^e By aurification or aurifaction?

^f In this connection it is interesting to read in a Thang text that by taking a half-dose of a potent elixir, one can delay the decision to become a celestial immortal, thus living eternally on earth, impervious to harm and possessing praeter-natural powers. The other half-dose will then at any time admit one to the ranks of the celestial immortals (*Huang Ti Chiu Ting Shen Tan Ching Chüeh* (TT878), ch. 2, p. 4a).

¹ 白石先生

² 金液

³ 太素傳

⁴ 仙官

⁵ 上成公

⁶ 陳寔



Fig. 1308. The holy immortal Pai Shih hsien-sêng (Mr White-Stone), type of all *ti hsien*, enjoying the pleasures of his farm (*Lieh Hsien Chhuan Chuan*, ch. 2, p. 17a).

(d. +187) and Han Shao¹ (d. +192).^a Chungchhang Thung² (d. c. +230) also wrote about it in his *Chhang Yen*³ (Auspicious Affirmations),^b and though he gave the immortal a different name (Pu Chhêng⁴), and made the witnesses the fathers and grandfathers of Chhen and Han, none of these scholars was particularly Taoist. Later centuries saw a great elaboration of the celestial and terrestrial ranks of the immortals, but it is interesting to look briefly at some of the formulations in the *Thai Phing Ching*, roughly contemporaneous, as we know, with the scholars just mentioned. In this we can read:^c

Among the thirty-six thousand things in the universe, longevity is the best. In this heaven comes first, then earth, then the *shen jen*,⁵ then the *chen jen*,⁶ then *hsien jen*,⁷ then *tao jen*,⁸ then *shêng jen*,⁹ then *hsien jen*¹⁰—these eight partake of the mind of royal Heaven, and share its will and power. They are all men of Heaven, the kind of men that Heaven needs for official position (in the celestial bureaucracy), so they all have concern for the same thing, that which Heaven most loves, the nourishing of men and women. Heaven most prizes longevity, beyond the span of ordinary life. The immortals (*hsien jen*⁷) also most prize longevity as well as life. Those who prize life dare not do the works of death, because each of them cares about the preservation of his own body (and souls).

One can see here the appearance already in the +2nd century of a distinct ethical element.^e From other places in the same book one can construct a kind of ladder of ranks extending from the earth to the heavens.^f All could rise in this order by study and practices, including no doubt the ingestion of elixirs.

name		symbolising
<i>shen jen</i> ⁵	divine immortals ^g	heaven
<i>chen jen</i> ⁶	perfected immortals	earth
<i>hsien jen</i> ⁷	immortals ^h	four seasons
<i>tao jen</i> ⁸	masters in the Tao	five elements
<i>shêng jen</i> ⁹	sages	Yin and Yang
<i>hsien jen</i> ¹⁰	secondary sages	mountains and rivers
<i>shan jen</i> ¹¹	doers of good	—
<i>min jen</i> ¹²	ordinary people	the ten thousand things
<i>nu pei</i> ¹³	slaves	herbs and trees

^a Ch. 112B, p. 17b.

^b CSHK (Hou Han sect.), ch. 89, p. 8b, derived from PPT/NP, ch. 5, p. 7a, b, which preserved it. Tr. Ware (5), p. 108.

^c Wang Ming ed., pp. 222-3, tr. auct. On the complicated history of this text see Hsiung Tê-Chi (1).

^d It is interesting that the names for sages commonly used by the Confucians come rather low in the list.

^e This is manifest also from other passages, e.g. pp. 138-9, 596, rough translations of which will be found in Yü Ying-Shih (2), pp. 112, 114. Confucianism and Buddhism were already beginning to take effect.

^f Wang Ming ed., p. 221.

^g Their dwelling is the north celestial pole (*pei chi*¹⁴) and the Purple forbidden enclosure (*tsu kung*¹⁵).

^h These presumably included both of Ko Hung's two lower categories.

¹ 韓昭

² 仲長統

³ 昌言

⁴ 卜成

⁵ 神人

⁶ 真人

⁷ 仙人

⁸ 道人

⁹ 聖人

¹⁰ 賢人

¹¹ 善人

¹² 民人

¹³ 奴婢

¹⁴ 北極

¹⁵ 紫宮

Thus was elaborated a hierarchy of saints, from the meanest earthly mortal to the everlasting dweller in the constellations.

By the end of the +3rd century the celestial bureaucracy was fully in being, as is shown by the *Têng Chen Yin Chüeh*¹ (Confidential Instructions for the Ascent to Perfected Immortality)^a consisting of documents from the neighbourhood of +366, edited with a commentary by Thao Hung-Ching² between +493 and +498. It was revelations from members of the same heavenly hierarchy that this great physician and expert in many sciences and proto-sciences gathered at the same time from slightly later +4th-century records to form the *Chen Kao*³ (Declarations of Perfected Immortals).^b In this the ranks of the blessed ones are very clear.^c Another work of similar character from about +370 is the *San Chen Chih Yao Yü Chüeh*⁴ (Precious Instructions concerning the Message of the Three Perfected Immortals),^d edited subsequently in the Thang.^e To Thao Hung-Ching himself is attributed a book which deals with the ranks, dignities and administrative duties of the immortals; it is entitled *Tung Hsüan Ling Pao Chen Ling Wei Yeh Thu*⁵ (Charts of the Positions and Attributes of the Perfected Immortals, a Tung-Hsüan Ling-Pao Scripture)^f and it must in any case be of the early +6th century.^g By this time the original non-ethical pattern of ancient Huang-Lao Taoism, where the heavens were the heavens, i.e. the sky and the con-

^a TT418. We shall often refer to this again, e.g. p. 131 below.

^b TT1004.

^c For example, the alchemist Mao Ying⁶ (cf. p. 13) of the -1st century has become Director of Destinies and Grand Duke Minister of the Eastern Sacred Mountain, while his youngest brother Mao Chung⁷ remains an earthly *hsien* in charge of the immortality candidates at the great Taoist abbey of Mao Shan.⁸ Cf. Fig. 1309.

^d TT419, cf. Maspero (7), p. 376.

^e These were Hsü Mi⁹ (fl. +345), Yang Hsi¹⁰ (fl. +370) and Hsü Mi's nephew Hsü Hui¹¹ (fl. c. +360). The case of the last-named raises the question of the use of suicide by ecstatic Taoists as a means of joining the ranks of the immortals. At the age of 30 Hsü Hui thought that he had received an 'untimely summons', with assurance of enviable official rank in the 'world beyond', by a dream of his master, Yang Hsi (*Chen Kao*, ch. 17, pp. 5b, 6a), so he shuffled off his earthly coils in +370. A second case occurred in Thao Hung-Ching's own time, in +515, that of Chou Tzu-Liang,¹² at the early age of 20, convinced of brilliant promotion among the immortals (*Ming Thung Chi*,¹³ ch. 1, p. 11a). The means of egress remain uncertain, but Thao himself suspected poisonous fungi (*Ming Thung Chi*, ch. 4, p. 19a, b), which in view of the plant elixir tradition and the hallucinogenic agents in some mushrooms (cf. p. 116) would seem very probable. From all this one can appreciate something of the intensity of the faith of the Taoists of Chin and Liang in their religious world system. The general context was the veneration for the 'empty tombs' of men who were believed to have become immortals, and these were often described as having achieved their aims through elixirs which did not lead to continued palpable life on earth but carried them through into the realm of the heavens (*Chen Kao*, ch. 14, pp. 16aff.). Such 'medicines' would clearly have been toxic. But cases such as those of Hsü Hui and Chou Tzu-Liang were distinctly rare, and Taoism never had that marked and continuous tradition of suicide for the attainment of paradise or nirvana which was present in Buddhism from the beginning. Indeed one might well suspect that these Taoist phenomena were really Buddhist in inspiration. We are much indebted to Mr Michel Strickmann for information and consultation on this subject. Cf. Strickmann (2, 3).

^f TT164.

^g How long this genre continued can be seen by the work of Chang Thien-Yü¹⁴ of the Yuan period, some eight centuries later, the *Hsüan Phin Lu*¹⁵ (Record of the Different Grades of Immortals), TT773; a work somewhat resembling the *Lieh Hsien Chuan*.

¹ 登真隱訣

² 陶弘景

³ 真誥

⁴ 三真旨要玉訣

⁵ 洞玄靈寶真靈位業圖

⁶ 茅盈

⁷ 茅衷

⁸ 茅山

⁹ 許謐

¹⁰ 楊羲

¹¹ 許謐

¹² 周子良

¹³ 冥通記

¹⁴ 張天雨

¹⁵ 玄品錄

stellations, within this world, and continuance of the body and its souls, either here or up there, depended far more on techniques (including chemical elixirs) than on ethically judgeable behaviour, had come into syncretistic combination with the heavens of Buddhism, i.e. true ethically-determined other-worldly heavens, and the new element of other-worldly hells had been introduced as well. This process had started early in the +3rd century, and integration was far advanced by the mid +4th, the time of the Three Perfected Immortals just mentioned.

The Confucians, of course, cared for none of these things. They might have liked the physical immortality cult better once it had taken on a markedly ethical colour, largely though perhaps not entirely under the influence of Buddhism; but permeation by the truly other-worldly heavens and hells was a part of the same process, and that repelled them even more. The Confucians regarded the whole business as a dangerous diversion from man's earthly duties, and would willingly have called it (if they had thought of the expression) the opium of the people. This can be seen from the Chhin onwards. Early in the Han, in -196, Lu Chia¹ wrote in his *Hsin Yü*² (New Discourses):^a

(If a man) engages in hard and exhausting exercises, going deep into the mountains and seeking to become one of the holy immortals, (if he) leaves behind his parents, casts aside his kindred, abstains from the five cereal grains, and gives up classical learning, thus turning his back on what is cherished by Heaven and Earth in his quest for the Tao of deathlessness; then he can no more communicate with the people of this world, or prevent what is not (right from happening).

The same attitude could be illustrated from almost every decade of these centuries, as well as later on. For example, Wang Pao,³ in his essay of about -60 on the capacity of a sage-king to gather round himself sagely ministers, bitterly criticised immortals like Wangtzu Chhiao and Chhih Sung Tzu for having 'abandoned the common life and cut themselves off from the humanity of their generation (*chüeh su li shih*)'.^b Sometimes the position is a little ambiguous. Huan Than,⁵ a sceptical naturalist philosopher often quoted in our previous volumes, wrote in his *Hsin Lun*⁶ (New Discussions) about +20 that 'there is no such thing as the Tao of the immortals, 'tis but a fable of those who like to talk about weird things'.^c Yet in his earlier days he had written for the emperor the eloquent ode called *Wang Hsien Fu*⁷ (Contemplating the Immortals; a Hymn of Praise).^d Perhaps this was a conventional courtier's piece, perhaps he changed his mind as he grew older. Or perhaps we are too naïve in contrasting 'scientific scepticism', as we would understand it today, with 'superstitious belief' in the techniques of the holy immortals. Huan Than was indeed learned in the astronomy,

^a Ch. 6, p. 15b, tr. auct., adjuv. Yü Ying-Shih (2), p. 93. Cf. the Hebrew prophets, pp. 78-9 above.

^b CSHK (Chhien Han sect.), ch. 42, p. 10b. On these two immortals see Kaltenmark (2), pp. 35, 109.

^c Chang Hua in his *Po Wu Chih*, ch. 5, pp. 5b, 6a, says that Huan Than shared this strong conviction with his friend Yang Hsiung (cf. Vol. 3, p. 219). On Huan himself see Vol. 2, p. 367. The *Hsin Lun* statement is in CSHK (Hou Han sect.), ch. 15, p. 5b.

^d It is preserved in CSHK (Hou Han sect.), ch. 12, p. 7b, and several encyclopaedias. A critical edition and translation has been published by Pokora (3). The occasion for the ode was a ceremony in honour of Wangtzu Chhiao and Chhih Sung Tzu at a Taoist temple at the foot of Mt Hua Shan.

¹ 陸賈

² 新語

³ 王褒

⁴ 絕俗離世

⁵ 桓譚

⁶ 新論

⁷ 絕仙賦

mechanics and other sciences of his time, but he also left much other information on the Taoists, and in considering what they did he may well have recognised the real value in many of their psycho-physiological and therapeutic methods. When a Ptolemy could take horoscopes seriously, who in the +1st and +2nd centuries could have been expected to differentiate successfully between science, magic and mysticism?

The Taoists defended themselves in many ways. It may suffice to choose one magnificent passage from the *Pao Phu Tzu* book, in which Ko Hung replied to the charge that becoming an immortal was an act of treachery to one's ancestors in that they would no longer receive the sacrifices that were due from their descendants.^a

Some one said: 'If people could learn how to become holy immortals, ascending the clouds, turning their back on the life of the community and spurning the world, then they would no longer offer the customary sacrifices of food to their ancestors. If the spirits were to know about this, would they not then have to go hungry?'

Pao Phu Tzu replied: 'I remember having been taught that the height of filial piety is to keep one's body unharmed and intact. Would it not be far more filial then to acquire the Tao of the *hsien* which leads to eternal life and perpetual awareness, giving an existence as long-lasting as Heaven and Earth themselves, not merely returning (into the dust) intact that which one has received complete from one's parents? Now once we can mount into the empty air and tread upon the light, with clouds as our vehicles and rainbows for canopies, we shall be able to taste the dews of roseate morning vapours, and quaff the intoxicating essences of the deep blue (heavens) and the yellow (earth). For drink we shall have nectar of jade and ambrosia of gold, for food we shall taste caerulean iridescent mushrooms and vermilion-red flowers; our dwellings will be halls of jasper and sardine-stone, with rooms composed of rufescent gems; and we shall wander at will in the realm of the Great Purity (*Thai Chhing*). If the spirits of our ancestors come to know about this, will they not participate in our glory? They may act as assistants to the Five Emperors, or take charge of the hundred spiritual forces. They will receive preferment without having to seek for it. They will feed upon blossoms and edible jade. Their influence will reach to the confines of Mt Lo-fêng.^b Their prestige will be announced resoundingly among the beams and pillars (of the heavenly palaces). If we sincerely follow this Tao, even though they do not understand its mystery, they will assuredly never go hungry.'

O quanta qualia sunt illa Sabbata! Fundamentally different in various ways though the Christian heavenly vision may have been, Ko Hung's description certainly recalls the wonderful poetry of Abelard^c and Bernard of Cluny.^d

I know not, O I know not,
What social joys are there,
What radiancy of glory,
What light beyond compare.

But the Confucians remained unconvinced.

^a *PPT/NP*, ch. 3, p. 7a, tr. auct., adjuv. Ware (5), pp. 63-4.

^b Another abode of the spirits, something like the Yellow Springs.

^c +1079 to +1142. The hymn on the perpetual feast-day in heaven, the first line of which is here quoted, was translated by J. M. Neale (cf. *English Hymnal*, no. 465).

^d The lines following are from his *Hora Novissima*, also translated by Neale (1); cf. *English Hymnal*, no. 412. His *floruit* was in the mid +12th century.

¹ 太清

² 羅鄧山

We have been talking about ascensions (pp. 104 ff.) and we shall soon have more to say on them (pp. 124 ff.), so perhaps this is the place to mention two wonderful Han pottery tomb-models showing magical birds about to take off for the upper regions with alchemists and their reaction-vessels on board. These models were discovered in 1969 in a tomb at Shadowless Hill (Wu-ying Shan) near Chinan in Shantung dating from the 1st or 2nd century; cf. Anon. (113). Fig. 1337 shows the two alchemists saluting each other, backed by elixir *ting* cauldrons with anthropomorphic feet supported on the wings of the bird, while an attendant aft is holding over them a ceremonial umbrella. The same tomb also yielded a somewhat larger model, seen in Fig. 1338; this bird carries only two great *hu* pots, doubtless filled with elixirs.

The whole tradition which we have been describing here lives on in literary usage today. We cannot forbear from quoting the touching lines which Mao Tsê-Tung addressed in 1957 to a woman school-teacher at Chhangsha, Li Shu-I¹—‘here is a poem in the Wandering Immortals (*yu hsien*²) style’, he said, ‘dedicated to you’. Li Shu-I’s husband, Liu Chih-Hsün,³ a comrade-in-arms of Mao, had died in the battle of Hung-hu in 1933, while three years earlier Mao’s first wife, Yang Khai-Hui,⁴ a great friend of Li’s, had been killed by a Kuomintang official when the Red Army retreated from Chhangsha. Now Yang means poplar and Liu means willow.⁵ So Mao wrote:

Long have I lost my brave Yang poplar-tree
And Liu, your spreading willow, was cut down;
But silk-haired poplar seeds and willow wisps
Float up, and they rose up, to the ninth sphere.
Passing the moon, they tarried, and Wu Kang⁶
Gave them to drink of golden cassia wine^c
(That has the medicine of eternal life).
Chhang O⁶,^d the lonely goddess, honoured these
Loyal souls, and spread her sleeves, and danced for them
All through the boundless spaces of the sky—
Suddenly comes the news of the Tiger’s defeat on earth
And uncontrollable tears burst forth like torrents of rain.^e

¹ Liu,⁷ most specifically, means the weeping-willow, *Salix babylonica* = *pendula* (CC 1697), and it is often called *yang liu*⁸ (R 624), probably to indicate its monoecious character, the floating seeds coming only from the female tree. But *yang*⁹ is also a generic name for all the species of poplar, *Populus* and *Salix* together form one family, the Salicaceae (Lawrence (1), p. 447).

² Wu Kang was the Sisyphus of Chinese legend. In the *Yu-Yang Tsa Tsu*, for example, we are told that because of some fault he had committed in his search for immortality, he was doomed to cut down the cassia tree, 5000 ft high, in the moon, but for every branch that he lopped, another instantly grew in its place.

^c *Cinnamomum Cassia* = *aromaticum* (R 494, CC 1318).

^d See Vol. 5, pt. 3.

^e Tr. auct., adjuv. Sollers (1), p. 39; Ho Ju (1), pp. 30, 48; Huang Wên (2), pp. 54, 91 ff.; Bullock & Chhen, in Chhen Chih-Jang (1), p. 347.

¹ 李淑一

² 遊仙

³ 柳直荀

⁴ 楊開慧

⁵ 吳剛

⁶ 嫦娥

⁷ 柳

⁸ 楊柳

⁹ 楊

(v) *Macrobiotics and the origin of alchemy in ancient China*

If we now look back upon the way we have come, we can see that several things have been established concerning macrobiotics in relation to the origin of alchemy in China.

(1) In spite of some metaphorical formulations, elixirs giving permanent life, medicines of immortality, in short macrobiogens of various kinds, were not a serious element in Hellenistic proto-chemistry, which concerned itself more with aurification and aurifaction, however mystically conceived; but the Chinese, from the -4th century, certainly from the -3rd, believed in them absolutely.

(2) The kind of immortality which they envisaged was fundamentally a physical or material one, a perpetuation of existence within the natural world under the sun, whether on earth, or in the sky among the constellations.^a There had been in Chinese thought, it is true, a shadowy underworld (paralleling She'ol or Hades), but there had not been, and until the seeping in of Buddhism there would not be, an 'ethical polarisation' whereby the sheep and the goats were judged and separated into other-worldly heavens and hells. A material medicine or elixir of plant or mineral-metallic origin was therefore entirely conceivable, for all medicines maintain or restore the health of the body-soul organism, and *hsien* immortality was after all only a kind of indefinite continuation of this health. A material medicine could hardly be envisaged by anybody as a passport to an other-worldly ethically determined paradise, or a safeguard against dismissal to a deserved purgatory or hell. The attainment of the status of the 'holy immortals' depended primarily upon techniques, physiological, chemical and magical-liturgical—practices (not all by any means necessarily 'ascetic', as that word has been understood in the Indo-European civilisations) in a long training whereby the body was etherealised or rarefied to the utmost, but conserved. Immortality, therefore, like everything else in true Chinese thought-style, was 'this-worldly'.

(3) Why the body was necessary appears clearly from the old Chinese doctrine of the souls, since no theory of a unitary soul, or *deus ex machina*, spontaneously developed there. On the contrary, one or more *hun* souls (ultimately three) were bright, aerial and ouranic (Yang) in nature, bound therefore to merge at death with the upper airs; while one or more *pho* souls (ultimately seven) were dark, earthy and chthonic (Yin) by nature, doomed therefore to dissolve in the terrestrial essences. The souls were like beads on a rosary or *masbahah*; the body was the only thread that could hold them together.

^a From the foregoing pages certain aspects of an importance here comparatively secondary emerged. As time went on greater emphasis was given to ascent into the (material) heavens; this was probably due, we suspect, to the fervent desire for survival in Taoist immortality manifested by successive emperors and high officials from the foundation of the unified empire in the late -3rd century onwards. Something prestigious had to be reserved for them in the 'world to come'. At the same time there grew up in the heavens, with residences and offices in the stars and constellations, a celestial bureaucracy formed in the very image of the imperial bureaucracy on earth, and by the +4th century preferment therein was the main aim of those ambitious for *hsien* immortality; though a few Cincinnati might still insist on the old vision of unending contentment among the mountains and forests, or even the habitations of men, on earth. Cf. Fig. 1309.

These three considerations suffice to show that from the -4th to the +1st centuries intellectual conditions in China were extremely propitious for the development of the elixir idea (and the aurifaction which went with it from at least the mid -2nd century onwards). But was the drug of deathlessness an indigenous concept or did it come, even as a kind of stimulus diffusion,^a from somewhere else? Chinese and Japanese scholars have addressed themselves to this question for a long time past, with very varying conclusions. Some have thought that they could trace it to the influence of tribal peoples on the fringes of nascent Chinese civilisation, e.g. Hsü Chung-Shu (7), who nominated the northern Ti¹ barbarians active during the -8th century, and Wên I-To (3), who believed that the western Chhiang² people, with their practice of cremation, were responsible. But none of this evidence is very convincing. Tsuda Sōkichi (2), half a century ago, in what is still the most elaborate monograph on the birth of Chinese immortality ideas, tended to believe in a purely indigenous and natural train of thought leading from longevity to immortality.^b If so, it was obvious that the people of the States of Chhi and Yen on the north-eastern littoral were largely responsible. In +1662 Ku Yen-Wu suggested that they derived their ideas from oceanic mirages,^c and this has had the support of Takeuchi Yoshio (1) and a number of other scholars in recent times, but at best it explains the mysterious islands of Phêng-Lai, not at all the immortals on them, still less the drug of deathlessness itself.

From everything so far said it is evident that China in the Warring States, Chhin and Han periods would have provided precisely the supersaturated solution from which elixir alchemy would crystallise given the right seed. Twenty-five years ago Dubs (5) proposed that this seed was a knowledge of (or a hearsay about) the Indo-Iranian plant used by the Vedic clergy in their sacrifices late in the -2nd millennium. Called *haoma* by the Persians and *soma* by the Indians, its use must antedate the Aryan invasions because the practice is firmly attested both by Avestan and Vedic sources.^d The juice of this plant was believed, as far as one can tell from the phraseology of the hymns, to cure all diseases of body and mind, and to confer immortality. Dubs went on to suggest that the means of transmission to China was the Yüeh-Chih³ people, who occupied western Kansu down to the -3rd century, with their chief city at Kanchow (mod. Changyeh),^e the people, in fact, whose alliance Chang Chhien went to seek in Han Wu Ti's time after they had moved further to the West.^f Thus Dubs envisaged an overland transmission of the idea of the drug or plant of immortality from the Iranian culture-area to China early in the -4th century if not before. There he left the matter. On first reading this thesis I was by no means attracted to it, for although it had the advantage of not assuming contacts with India at this early date (so often proposed,

^a See Vol. 1, pp. 244 ff.

^b The historian of Taoism Hsü Ti-Shan (1, 2) always agreed with this.

^c *Thien-Hsia Chün Kuo Li Ping Shu*, ch. 18, p. 36a, b. Ku was also one of the first scholars to point out that the idea of *hsien* immortality started only in the Late Chou period.

^d *Rg Veda*, VIII, IX. *Avesta*, Yasna IX, 2, 19, X, 7, 9, XI (the Hōm Yašt chapters).

^e Cf. Vol. 1, p. 181, Vol. 4, pt. 3, p. 10.

^f Cf. Vol. 1, pp. 173 ff.

so rarely supported with convincing evidence), it seemed to bring the idea to Chhin State in north-west China first rather than to the north-east, which would contradict a mass of facts about the Taoist primacy of Chhi and Yen.

This difficulty still remains, but the whole subject has been placed in an entirely new light by the discoveries of R. G. Wasson and his collaborators.^a In the course of a general survey and extensive field investigations of hallucinogenic plants,^b including the cacti^c and the fungi,^d the role of psychotropic substances in ancient religions and philosophies is being at last revealed.^e Particularly the fly-agaric, *Amanita muscaria*, is relevant, a mushroom with a bright scarlet cap beneath a white veil which disappears as it ripens; associated with the birch (*Betula*) and to a lesser extent with forests of pine. The fly-agaric (Fig. 1310, p. 125) was still used in this century by the Gilyak, Koryak and Chukchi shamans of north-eastern Asia for inducing their ritual ecstasies, imagined flights, safe-conducts of souls and visits to the gods.^f The key suggestion is then that the orange-coloured juice of this mushroom was the *haoma-soma* of the ancients, for the Vedic hymns clearly imply ecstatic visions in those who participated in the rites. All the textual descriptions, it is urged, are compatible in detail with this mushroom as the sacred plant, and one also which came from temperate zones on the slopes of the high mountain ranges in the north. The suggestion becomes still more plausible (apart from a mass of other evidence)^g when one knows that the psychotropic substances can pass through the human body unchanged up to five times, while the accompanying nauseant principles are metabolised and lost; now the drinking of the urine of the officiating priest is known for the shamanic, and textually inferred for the vedic, ceremonies.^h The Vedas unmistakably say: 'Soma strengthens the weak... prolongs life, gives divine power to the gods', especially Indra, and the moon, Chandra.ⁱ They also constantly repeat: 'We have drunk the soma, we have become immortal,

^a See especially Wasson (1, 3); Wasson & Wasson (1); Heim, Wasson *et al.* (1).

^b E.g. the Aztec *ololiuqui* from the convolvulaceous *Rivea corymbosa*, which contains lysergic acid derivatives; Schultes (1); Osmond (1). The Zapotecs use the seeds of a related plant *Ipomoea violacea*; Wasson (1).

^c The Mexican *peyotl* (mescal) from *Lophophora Williamsii* has long been known; see the reviews of la Barre (1, 2).

^d On psilocybine from the genus *Psilocybe* spp. the basic paper is that of Heim & Hofmann (1); cf. Heim (1, 2); Deysson (1). These are the mushrooms used by the Zapotec, Mazatec and Nahua Indians of Oaxaca, Mexico, with whom the Wassons received the 'flesh of the god' (Wasson, 1).

^e As well, needless to say, as among contemporary tribal and proto-literate peoples. There is already a large literature on the ethno-pharmacology of psycho-active drugs, from which for the moment we shall only quote the symposium proceedings edited by Efron, Holmstedt & Kline (1); the collective works edited by Solomon (1); Crockett, Sandison & Walk (1); Clark & del Giudice (1); Keup (1) and Walaas (1); and the books of Gray (1) and Hoffer & Osmond (1). Much historical research remains to be done to test suggestions such as that of Wasson (1) that the Eleusinian Mysteries involved the taking of hallucinogens. On the value of these drugs in psychiatric research see Osmond (1).

^f For the chemistry of the hallucinogen see Eugster (1); Efron *et al.* (1); Razdan (1).

^g For example, the holy drink cannot have been a fermented liquor because it took effect immediately after the plant was crushed and extracted. The traditional root of the words *haoma* and *soma* has been 'to squeeze'; Modi (1); Hopkins (3); but modern research suggests 'spongy' (Bailey (1), p. 105).

^h Cf. Wasson (3), p. 29. It may still be too early to regard the case for *A. muscaria* as demonstrated, but sanskritists and ethno-pharmacologists are reaching agreement that the *soma* plant was a hallucinogenic one of some kind. See Wasson & Ingalls (1); with the critique of Brough (1) and Wasson's reply (4).

ⁱ Cf. Hopkins (3). The Avestan writings also say that *haoma* gives health, longevity, wisdom, greatness and power (Modi, 1).

we have entered into the light, we have known the gods.^a Thus the participating worshipper was healed and made imperishable (*amṛta*).^b It is a little difficult to be precise about the nature of the immortality which the drinkers of the *soma* juice believed that they had acquired, or would attain, but having once experienced what they felt was a visit to the paradise of the gods they were presumably assured that they would be able to go there again. They were persuaded in fact that they had already shared the life of the gods.^c Evidently we have here something far more concrete than the metaphors of the Hellenistic Graeco-Egyptian proto-chemists, and something which would have supplied just that element of solid faith which was needed to make the Chinese Taoist set of ideas gel into full elixir alchemy.^d Thus the plant of deathlessness (*pu ssu chih tshao*¹) could have been the fly-agaric, and the tree of deathlessness (*pu ssu chih shu*²) could have been the birch. The transition to mineral-metallic (golden) elixirs would have been a slightly later step taken presumably under the influence of the proto-chemical and metallurgical practitioners of Chhi and Yen.

How this could have come about can be seen most strikingly if we examine ancient Indian liturgical texts. At the outset of this disquisition (p. 12) we defined the essential germ of alchemy as macrobiotics plus aurifaction, noting by the way that the connection of the idea of eternal life with the incorruptible metal gold as such was probably a good deal older. It is easy to say that this thought-connection must go back to the very first knowledge of the properties of metals, but we are entitled to ask for something more concrete than that. When one looks for it in texts of ancient Egypt or the Fertile Crescent there is not much to be found. For example, Moret, in his discussion of the

^a *Rg Veda*, VIII, 48, 3. Cf. Muir (1), vol. 2, p. 469, vol. 5, p. 258; Hillebrandt (1). See also Wilkins (1), pp. 69ff., 72; Masson-Oursel, de Willman-Grabowska & Stern (1), p. 147.

^b Macdonell (1). This word has quite a large part to play later on in the epic literature, including the *Mahābhārata*, where it means the Drink of Immortality itself, produced by the churning of the ocean (cf. Keith (5), vol. 2, pp. 623-4). This too could have had some influence, conceivably, on Chinese ideas. *Amṛta* is cognate with the Greek *ambrosia* (Fowler (1); Zinner (1), pp. 60, 105), just as *amūrta* (incorporeal) parallels *abrotos*.

^c Cf. Wasson (3), pp. 209-10.

^d One difficulty that remains in this interpretation is the fact that, as is generally agreed, the *soma* sacrifices in India ceased about -800 and the Brahmins substituted other, psycho-inactive, plants for the original mushroom (Wasson (3), pp. 5, 69, 95ff.). It is supposed that the supply from the Himalayan regions became more difficult as the Indo-Aryans spread out into the Dravidian south, but that will not explain why the *haoma* sacrifices also ceased at an early date in Persia. Nor is it obvious why another psycho-active mushroom or flowering plant was not chosen as substitute in both cases. Moreover, some four or five centuries would have intervened between the ending of the immortality-hallucination rites and the coming to China of the idea of a plant of deathlessness. Still, this gap seems not so serious when we remember that the hymns which had accompanied the rites both in Persia and India, together with other relevant texts, had been written down, or at least memorised word-perfect, by many Brahmins and Avestan scholars, only a few of whom would have been required to transmit the thrilling seminal idea to Chinese culture. Nor do we need to imagine that they came in person.

A third problem also presents itself, the paradox of the appearance of the pharmacological *soma-haoma* 'passport' to heaven in just those cultures which were developing the clearest and most widely influential other-worldly 'ethical polarisation' (p. 80 above). But we may cogitate two things: first, the wonder-plant had not begun with them, for it reaches back to -3rd-millennium Sumeria (p. 121), and secondly, the growing ethical factor was perhaps precisely the reason why the *soma* sacrifices ceased in them. Apparently Zoroaster himself (prob. -620 to -550) was against the plant, and the urine too (cf. Wasson (3), p. 32). So perhaps the Indo-Iranian cultures were but way-stations between Gilgamesh and Chhin Shih Huang Ti.

¹ 不死之草

² 不死之樹

religious basis of pharaonic royalty, says that 'what flowed in the veins of the Pharaoh, the son of Rā, was the "liquid of Rā, the gold of the gods and goddesses"; what gave him life was a luminous fluid issuing from the sun, "source of all life, all strength and all duration"'.^a Inscriptions say: 'The ichor of Rā is the gold of his rays.' But this is hardly more than poetical metaphor. What is much more important for us is the remarkable fact that in ancient India gold was intimately bound up with the *soma* sacrifice itself. This is clear from many passages of the *Śatapatha-brāhmaṇa*, datable like all the Brāhmaṇas between the -8th and the -4th centuries, but probably mostly of the -7th. This work is a veritable treasure-house of liturgiology,^b and gold (*suvarṇa*) is continually mentioned in it. Let us study a few examples.

Gold is the semen of the fire-god Agni,^c the purest of earthly things, a sacramental symbol of light, fire and immortality, as the formulae repeat over and over again.^d The myth goes thus:

He (the priest) then brings (an object of) gold. Now Agni at one time cast his eyes on the Waters. 'May I pair with them', he thought. He came together with them, and his seed became gold. For this reason the latter shines like fire, it being Agni's semen. Hence too it is found in water, for he poured it in.^e Hence also one does not cleanse oneself with it, nor does one do anything else with it.^f Now there is splendour (to honour the fire), for he (the priest) thereby makes it to be possessed of divine seed...^g

Already we have a passage of strangely alchemical significance, in view of the *conjunctio oppositorum* and the 'marriage of fire and water', though written and recited perhaps half a millennium before the birth of alchemy. Another version says that after Indra slew Viśvarūpa, son of Tvashṭri, the latter burst him into fragments, and 'from his seed his form flowed and became gold'.^h Afterwards the gods re-integrated him, so the priests 'purify by means of gold, that metal doubtless a form of the gods'.ⁱ And, 'by means of gold they cleanse themselves, for gold is immortal life, and in this they thus establish themselves'.^j 'For gold is light and fire is light, gold is immortality and fire is immortality'.^k During the liturgy a piece of gold is laid on the altar,^l in the footprint of the sacrificial cow,^m and in the wheel-track of the *soma* chariot.ⁿ More, at

^a (3), pp. 47-8.

^b Almost indeed the root of practice in all later organised religions.

^c A transference of the mysterious and magical generative, and hence life-giving, power of male semen to the glittering metal. Also probably a reference to its production by smelting processes. Cf. the argumentation of Eliade (5), and what is said by Gowland (9), pp. 196 ff. In this connection it is interesting that one of the alchemical cover-names for cinnabar in Chinese alchemy was *jih ching*, 'seminal essence of the sun' (*PPT/NP*, ch. 4, pp. 9b, 10b, Ware tr., pp. 82 ff.).

^d Sheppard (6) has the merit of having emphasised this. On the religion and mythology of the Brāhmaṇa books Devasthali (1) is also worth reading (cf. esp. p. 96).

^e Surely a reference to placer gold.

^f Except liturgically and for ornamentation.

^g *Śatapatha-brāhmaṇa*, II, (1), i, 5 (Eggeling tr., vol. 1, p. 277).

^h XII, (7), i, 7 (tr., vol. 5, p. 215).

ⁱ XII, (8), i, 1, 15 (tr., vol. 5, p. 236).

^k VII, (4), i, 15 (tr., vol. 3, p. 366).

^l III, (3), i, 3 (tr., vol. 2, p. 59).

^m III, (5), iii, 13, 14 (tr., vol. 2, p. 130).

ⁿ 日精

^j XII, (8), i, 22 (tr., vol. 5, p. 239).

^k III, (2), iv, 8, 9 (tr., vol. 2, p. 54).

the *soma* sacrifice there is a ritual buying of the *soma* (mushrooms)^a and this must be done with pieces of gold.

The Buying of *Soma*.

... why he (the priest) washes his hands. Clarified butter being a thunderbolt and the *soma* being a seed he washes his hands lest he should injure the seed, *soma*, with the thunderbolt, the ghee. Thereupon he ties the piece of gold to the (ring) finger. Now twofold indeed is this (universe), there is no third, truth there is and untruth; the gods are the truth and men are the untruth. Gold having sprung from Agni's seed, he ties the gold to this (finger) in order that he may touch the stalks (of the *soma*) with the truth, and handle it by means of the truth...^b

He then makes (the sacrificer) touch the gold and say: 'Thee, the pure, I buy with the pure.' For he indeed buys the pure with the pure, when (he exchanges) gold for *soma*, 'the brilliant with the brilliant'... 'the immortal with the immortal'...^c

Moreover, gold threads were woven into the strainers for the *soma* juice.^d At certain points in the service the priest had to stand on a piece of gold,^e and it was in gold that his fee was to be paid.^f

Gold also entered into many of the other sacrificial liturgies. It was involved in astronomical symbolism, held up to symbolise the sun^g or wrapped in *darbha* grass and carried westwards with the same intent.^h It was a recourse in expiatory procedures—if the fire goes out, the priest may offer gold 'for gold is Agni's seed... and the son is the same as the father'.ⁱ This was in the Agnihotra liturgy, morning and evening libations of milk, 'indeed a sacrificial (rite) ensuring death (only) in old age, for people are set free from it only by long-deferred death'.^j If an Agnihotra priest should die, 'the celebrant inserts seven pieces of gold in the seven seats of his vital breaths (*prāṇa*), for gold is light and immortality; thus bestows he light and immortality upon him'.^k Gold figured also in the consecration of a king, who must tread upon a plate of gold having 100 holes for as many years of longevity, and nine orifices for the nine vital *prāṇa*.^l Another kind of gold plate, and the gold image of a man, were essential cult objects in the Agnicayana sacrifice in which the fire-god was exalted.^m The gold plate, with its 120 knobs representing the rays of the sun, was identified with Indra, or Sūrya the sun; the image with Agni himself, or Prajāpati the creator.ⁿ Whenever he who knows the symbolism of the golden plate and the golden man 'departs this life,

^a The actual buying was probably done behind the scenes beforehand.

^b III, (3), ii, 1, 2 (Eggeling tr., vol. 2, p. 63). This same formula of the dawn *soma* pressing (*prātaḥ-savana*) is repeated at the Great *Soma*-pressing (*mahābhiṣava*), the midday pressing (*mādhyandina-savana*) and the evening one (*trīṭhya-savana*); cf. tr., vol. 2, pp. 238, 256, 390.

^c III, (3), iii, 6 (tr., vol. 2, p. 70). The procession and entry of the kingly *soma* follows.

^d V, (3), v, 15 (tr., vol. 3, p. 84).

^e V, (2), i, 20 (tr., vol. 3, p. 35).

^f IV, (5), i, 15 and XIV, (3), i, 32 (tr., vol. 2, p. 390, vol. 5, p. 503).

^g III, (9), ii, 9 (tr., vol. 2, p. 224).

^h XII, (4), iv, 6 (tr., vol. 5, p. 195). Here it is called, as in China, 'yellow' gold.

ⁱ XII, (4), iii, 1 (tr., vol. 5, p. 187).

^j II, (2), iv, 1-18 and XII, (4), i, 1 (tr., vol. 1, p. 322, vol. 5, p. 178).

^k XII, (5), ii, 6 (tr., vol. 5, p. 203).

^l V, (4), i, 12 ff. (tr., vol. 3, pp. 92 ff.).

^m VI, (7), i, 1 and VII, (4), i, 10, 15, 43, ii, 17, 18 and VIII, (1), iv, 1, VIII, (7), iv, 7 ff. (tr., vol. 3, pp. 265, 364 ff., 375, 382, vol. 4, pp. 18, 146).

ⁿ X, (4), i, 6 (tr., vol. 4, p. 342).

he passes into that body and becomes immortal, for death is his own self'.^a At sacrifices of cattle, other flat pieces of gold were used.^b Finally, in the greatest Indo-Aryan liturgy, the Asvamedha or horse-sacrifice, gold is inevitably prominent. The slaughtering knife is made of gold,^c 'for gold is shining light', and 'by means of the golden light the priest goes to the heavenly world'.^d And when the priest-king is invested with a gold ornament (*nishka*) by the Adhvaryu priest, they mutter, as if in versicle and response:^e

V. Fire thou art, light and immortality.

R. Gold indeed is fire, light and immortality.

[Fiery mettle, brilliance and everlasting life thus he bestows upon him.]

V. Protector of life, protect my life.

(R. Thy life is protected.)

[He thereby bestows vital strength upon him. He then says:]

V. Restrain thy speech.

R. For the sacrifice is speech.

Thus it is clear that in the ancient Indian liturgical theology of the first half of the — 1st millennium the idea of a connection between metallic gold and immortality, even if primarily symbolic, was very explicit. One can find it even earlier, in one at least of the hymns or spells of the *Atharva-veda*, a book mainly of the — 10th century, though this particular piece seems to be of rather later date, perhaps the — 8th. It is a charm or blessing to confer long life by the sacramental giving of a golden ring or earrings, especially for someone afraid of injury or death by fire. It runs as follows:^f

1. Gold that was born from Fire and is immortal
Hath been deposited with mortal creatures;
Whosoever knows this, verily he merits it,
Into extreme old age it will preserve him.
2. Gold that was sought by ancient men and sons
Bright and resplendent with the orb's own colour;
This shall endow thee, as it shines, with glory,
Long shall be the life of him who wears it.
3. Let it bring length of days and luminous lustre,
Strength, vigour, force and health attend thee;
So that egregious among the people
Thou shalt shine forth in golden radiance.
4. Gold that is known to royal Varuṇa
Divine Bṛhaspati, and Indra slayer of foes;
May it become for thee the source of life
May it shed over thee perpetual light.

^a x, (5), ii, 7, 23 (Eggeling tr., vol. 4, p. 368).

^b Especially placed above and below the omentum during its ritual cooking. III, (8), ii, 26 (tr., vol. 2, p. 197).

^c Or at least one of them was.

^d XIII, (2), ii, 16 (tr., vol. 5, pp. 303-4).

^e XIII, (4), i, 7 (tr., vol. 5, p. 348).

^f XIX, 26, tr. Griffith (1), vol. 2, p. 283; Bloomfield (1), pp. 63, 668-9; Whitney & Lanman (1), vol. 1, p. cxli, vol. 2, pp. 895, 936ff.; Renou (1), pp. 24-5, eng. mod. auct.

Such then, it would seem, is the background both of the 'plant of immortality' that Chhin Shih Huang Ti was to seek for, and the gold that Li Shao-Chün was to undertake to manufacture. Surely some rumour or persuasion of a most compelling character, reaching China, turned divinity into philosophy, or, to speak more precisely, liturgiology into proto-science.

One or two further points must also be mentioned. The idea of a herb of immortality was not at all a new invention of the Indo-Iranian cultures, for we can find it already in the Sumerian epic of Gilgamesh,^a datable before -2000. What relation that ancient legend had to hallucinogenic mushrooms or other plants remains completely in the dark, but an extrapolation backwards would make such a connection not at all implausible. Secondly, can we discern any traces of an enduring use of *A. muscaria* or other psychotropic fungi in Chinese culture? This is a fascinating question, still quite open. Wasson (2) was at first much inclined to believe that the 'magic mushrooms' (*ling chih*¹) so prominent in Taoist lore (Fig. 1311) were evidence of systematic ritual use of hallucinogenic substances, and we still strongly support this view, encouraged by some preliminary researches of Strickmann (1); but later Wasson felt less sure of it, partly because the numinous fungi classically portrayed in Chinese art (Fig. 1312) had to be identified as the inedible and pharmacologically inert genus *Ganoderma*.^b At the same time he fully accepted the view of Dubs that Indo-Iranian *soma-haoma*^c was the trigger for the searches of the First Emperor and of Han Wu Ti, even if it was only a stimulus diffusion.^d We believe on the other hand that whatever news it was that came from Persia^e or India (and we too now see the overland route

^a Cf. p. 117 above. See Widengren (1), and the translation of Sandars (1). The idea seems to have got even into Israel, of all places (cf. pp. 78-9). Isaiah (xxviii. 15 ff.) castigates, in the -8th century, certain men who said, 'We have made a covenant with death, and with She'ol we are in agreement; when the overflowing scourge shall pass through, it shall not come unto us...' See Oesterley & Robinson (1), p. 247.

^b (3), p. 87. He agrees, however (priv. comm. 1969, 1973), that the fly-agaric was known in China, as in several other cultures, by the name of toad-mushroom, *ha ma chün*² (Liu Po (1), p. 88), now often *tu ying hsin*,³ or fly-killing fungus (CC2288); though earlier the name 'red mushroom' (*hung hsin*⁴), normally applied to the psycho-inactive *Russula rubra*, may sometimes have referred to it (Wasson (3), p. 72). There are also Thang and Sung references to 'laughing mushrooms' (*hsiao chün*⁵), which may indicate *Panaeolus* or *Pholiota*, and suggest that the properties of at least some psycho-active fungi were widely known. Chhen Jen-Yü's⁶ *Chün Phu* of +1245 (p. 3a) calls them *tu hsin*.⁷ The further exploration of hallucinogenic fungi and other plants in Taoism and in Chinese culture in general will be an exciting task. Stuart (1), pp. 271 ff., could furnish a starting-point. We shall return to the subject in Vol. 6.

^c Hirth (9), pp. 13 ff., 25 ff., 28, thought, long ago, that he had detected a transliteration of *haoma* into Chinese in the traditional name for the many mirrors decorated with grape-vines and strange lion-like animals which have come down to us from the Thang period—*hai-ma phu-thao chien*,⁸ sea-horse and grape mirrors. Illustrations and descriptions can be found in *Hsüan-Ho Po Ku Thu Lu* (+1125), ch. 29, pp. 29a ff., *Hsi Chhing Ku Chien* (+1751), ch. 40, pp. 1a ff., or in Chhen Ching (1), ch. 2, pp. 45a ff. (1818). But there are several flaws in this, the mirrors are late, i.e. Thang, not Han, as was thought; the *haoma* was not fermented grape-juice anyway; and it would be reasonable for the animal name to refer to the animals. It must have some other origin. See further N. Thompson (1).

^d (3), pp. 80 ff.

^e Here we should not forget the six or seven 'holy immortals' (*spenta ame(r)sha*) of Iran, emanations or aspects of Ahura Mazda. The last of these, feminine in gender, was Amere(ta)tät, Absence-of-mortality herself. They were inseparable, like the Holy Trinity; and there was much in Chinese thought to which they could have given rise, including the famous company of the Eight Immortals (Pa Hsien¹⁰), one of whom was a woman. We are indebted to Dr I. Gershevitch for guidance in these Iranian realms.

¹ 靈芝

² 蛤蟆菌

³ 毒蠅菌

⁴ 紅罩

⁵ 笑菌

⁶ 陳仁玉

⁷ 菌譜

⁸ 杜鰲

⁹ 海馬葡萄鏡

¹⁰ 八仙

from the former region as more probable than the sea route from the latter),^a the properties of *A. muscaria* or related fungi were indeed known to, and used by, the ancient Taoists,^b perhaps the medieval ones also, though it will not be an easy task to reveal the details, doubtless among the most secret arcana of the *Tao Tsang*. In any event this case does not need proving now, and we shall return to it in Section 45 on pharmacology. The extraordinary prominence of cryptogams in all Taoist religious symbolism and iconography is surely inexplicable unless some among them had opened to the pure in heart the gates of the world of the holy immortals.

Take, just as one example, the romancé retelling of the favourite story of the naval expeditions in search of the plant of immortality, contained in the *Hai Nei Shih Chou Chi*,^c a tractate on the mythology of the oceanic islands attributed to Tungfang Shuo^d of the Han, but actually written in the +4th or +5th century. It says:^e

The Island of Tsu (Tsu-chou³) lies quite near in the Eastern Ocean, some 500 *li* away. Seventy thousand *li* beyond its western coast, there grows the herb of deathlessness (*pu ssu chih tshao*⁴); it seems to have the form of sprouts of water-grass (*ku*⁵),^d (with leaves) three to four feet long. If this plant is laid upon a man who has been dead for (as much as) three days, he will come to life again at once. If it is eaten, it will give longevity and immortality (*chhang sheng*⁶).

Formerly, in Chhin Shih Huang Ti's time, when the bodies of many men unrighteously and untimely killed were lying about at Ferghana^e and along the roads (that led there), birds resembling crows or ravens appeared carrying this plant in their bills, and placed it on the faces of those corpses, so that they immediately sat up and were restored to life. On this being reported by the officials to Chhin Shih Huang Ti, he sent an envoy with a sample of the plant to the Devil-Valley Master (Kuei Ku hsien-seng⁷), who dwelt outside the northern part (of the capital).^f 'This herb', the Master said, 'is the herb of deathlessness that grows in fields among the roseate rocks of the Isle of Tsu-chou in the Eastern Sea. Another name for it is "the (magic) mushroom that nourishes the spirit" (*yang shen chih*⁸)'. Growing luxuriantly in clumps, its leaves look like those of the water-grass, and one stalk of it suffices to raise a man from the dead.'

Hearing this, Chhin Shih Huang Ti was filled with enthusiasm and said 'Cannot this herb verily be fetched from there?' And straightway he despatched Hsü Fu⁹ to sea as admiral of

^a This was always the standpoint, too, of Chhen Yin-Kho (3).

^b Here may be mentioned the persistent reports of the drinking of urine by Taoist adepts from the early Han period onwards. We examine these in connection with the much later iatro-chemical isolation of the steroid sex-hormones; on which see Vol. 5, pt. 5, but in the meantime Needham & Lu Gwei-Djen (3); Lu & Needham (3). Such accounts are always a pointer, however, to the possible presence of *A. muscaria* hallucinogens, and a similar hint is found in the +12th-century reports of Lu Yu on the Manichees (Wasson (3), pp. 72 ff.). Perhaps the Taoists learnt from the Gilyaks (Wasson, p.c. 1973), cf. Vol. 2, pp. 104, 128.

^c P. 1a, tr. auct., adjuv. de Groot (2), vol. 4, pp. 307-8; Wasson (3), pp. 84-5.

^d Undoubtedly *Zizania aquatica* or *latifolia*, B III 197, CC 2067.

^e Reading Ta-Yuan¹⁰ for *ta yuan*.¹¹ If this was intended, there was a historical confusion, for the expeditions to Central Asia belonged to Han Wu Ti's time, not that of Chhin Shih Huang Ti.

^f Another confusion, for the writer of the *Kuei Ku Tzu* book, or most of it, whoever he was, lived in the -4th century, not the -3rd. The place from which he took his name is near Yangchêng in Honan, site of the age-old central astronomical observatory (cf. Vol. 3, pp. 296 ff.).

^g Or, the mental essences, or vitalities.

¹ 海内十洲記

² 東方朔

³ 祖洲

⁴ 不死之草

⁵ 菰

⁶ 長生

⁷ 鬼谷先生

⁸ 養神芝

⁹ 徐福

¹⁰ 大宛

¹¹ 大苑

a fleet of decked ships (*lou chhuan*)¹ with five hundred young men and women, etc. They duly sailed, outward bound in search of Tsu-chou, but none of them ever came back. Now Hsü Fu was a Taoist, with the *tsu* name Chün-Fang;² eventually (no doubt) he also obtained the Tao.

Here the interest lies in the fact that however the plant might be described, it was considered a mushroom. Wasson compares this story with two of later date from the Indo-Iranian culture-areas.³ The *Shahnamah* of Firdawsī, written just after +1000, tells of the journey of the physician Bursōē, in the time of the Sassanid king Khosru I Anushirvan (c. +550), to seek a shining herb of immortality in the Himalayas, having the property of reviving the dead—but even with the help of the Brahmins he fails to find it.⁴ Similarly the *Padma Pūraṇa*, written between +800 and +1000, has a legend about a mountain called Droṇa on which grew the *oṣadhi* herbs able to revive the dead; only by dismissing it to the nether world could the demon-king Jalandhara conquer Vishnu, whose heavenly hosts had been continually restored by the herbs.⁵ Now *oṣadhi* was one of the terms used for soma, and *droṇa* was the wooden cup or chalice used as container for the soma juice. Wasson suggests that all these legends derive from the hallucinogenic mushroom (Fig. 1310) used in the Vedic sacrifices. He might well be right.

At this point we must recur briefly to ethics. One might easily gain the impression, from the standpoint of Christendom, that no ethical element of any kind ever entered in to the original 'pure culture' of Chinese *hsien* immortality conceptions.⁶ But this would not be true at all because natural human affection impelled those who were convinced of the bliss of the *hsien* to seek it not only for themselves but for those near and dear to them, those that they loved. In ancient China this was far more of a live issue than it could ever become in Europe, even after the adoption of the elixir concept from the Arabs in the time of Roger Bacon, for in Europe where could an alchemical immortality be enjoyed? Prolongation of life, rejuvenation, a hale and hearty old age

^a See Vol. 4, pt. 3, pp. 441 ff. On the expeditions see also Vol. 4, pt. 3, pp. 551 ff. and Vol. 5, pt. 3 below.

^b (3), pp. 77, 79.

^c *Shahnamah*, vv. 3431–3568, tr. J. Mohl.

^d *Padma Pūraṇa*, pt. 2, bk. 6, ch. 8, vv. 40–63, tr. W. D. O'Flaherty.

^e In later times, of course, under Buddhist influence and Confucian pressure, Taoists preached conventional morality, as in the *Kung Kuo Ko*,³ which may be as old as the +8th century, and the *Thai-Shang Kan Ying Phien*⁴ of the early +11th (tr. Legge, 5). In such books as these may be found a scrupulosity rivalling the worst excesses of Latin Christianity. Cf. Vol. 2, p. 159. Particularly curious was the Taoist doctrine of the automatic subtraction of days, months and years from a person's life because of sins or bad actions committed. This appears already in the *Pao Phu Tzu* book (cf. e.g. ch. 3, p. 8b, ch. 6, p. 4b), and is prominent in the texts just mentioned. Apparently the gods calculated in units ('reckonings', *suan*)⁵ of three days. Buddhist compassion reacted against this in its turn in the doctrine of the saving invocation of Amida and the 25 Bodhisattvas, propagated by the Pure Land School (cf. Todo Kyoshun, 1)—something like the 'Jesus prayer' of the Hesychasts and other monastic groups in Eastern Orthodox Christendom.

Perhaps ideas of retribution were an ancient element in the folk religion which was absorbed into Taoism, at first ritual (tabu) rather than ethical, then gradually ethicised under Confucian influence. One suspects that the Buddhist *karma* doctrine, when it reached China towards the end of the Han, found something more than faintly similar already in possession.

¹ 樓船

² 君房

³ 功過格

⁴ 太上感應篇

⁵ 算

perhaps, might well be hoped for if the Philosophers' Stone was really the medicine of man as well as of metals; but this present world, denounced by a thousand preachers or accepted as a justly uncomfortable ante-chamber to the next, was hardly inviting enough to warrant an extended stay, and two-thirds of the next presented highly uncomfortable prospects. What a contrast was the Chinese world-view. Other-worldly ethically classified heavens and hells did not exist, but the visible world was real, eternal and uncreated,^a nor would it ever dissolve, and he or she who could achieve the requisite refinement,^b might continue to enjoy it with sense-perceptions purified and perpetuated. This was the meaning of the proverbial salutation: *Wan shou wu chang*!^c And once again proto-chemistry profited, for few women and no children could be expected to undertake the rigours of the life and the techniques of a Taoist abbey on a mountain-top; hence the elixir was the only practicable way. Thus the temptation to believe in the claims of alchemists was particularly strong in China, and one can see that a Confucian austerity almost heroic must sometimes have been needed to prevent men of high poetic sensibility not only from taking an elixir themselves but from inducing those near and dear to them to take it too. So in approaching the conclusion of this sub-section we must take up again the theme of Huang Ti (p. 105 above) ascending into the heavens on a dragon which carried, like a modern sultan's aeroplane, a complete *harim* and a cabinet of ministers.

It comes again in one important historical case of the — 2nd century, that of Liu An,² Prince of Huai-Nan³ (cf. Fig. 1313) the great patron of alchemists, naturalists and magician-technicians, whose name was given to the *Huai Nan Tzu* book. After allegedly planning sedition against the emperor Han Wu Ti he was condemned to commit suicide in — 122, but after his death or disappearance there quickly arose a rumour or legend that he had in fact ascended to the heavens as a *hsien*—and this not only with his whole family and household but also with all the domestic animals of the palace. All had ingested doses of a particularly potent elixir.^d There can be no doubt that much alchemical activity was going on at the court of Liu An, and even the names of many of his advisers and operators have been preserved (cf. pts. 3 and 4), so the story may well have been put about by those who remained behind after the prince and his family had decamped into some impenetrable wilderness. At all events, it exemplifies the kind of thing which could be widely believed at the time, and the role of alchemy in assuring the salvation of women and children who had not undergone the Taoist training.

One more instance may be given to show how far these ideas penetrated among the mass of the people. Yen Kho-Chün preserved in his collection the text of a remarkable Han inscription on stone, entitled Hsien Jen Thang Kung-Fang Pei⁴ (Memorial of the

^a Only differentiated, from primeval chaos. Cf. Vol. 2, *passim*.

^b It is interesting that this chemical term comes so naturally to the pen here.

^c Encountered by every visitor to contemporary Chinese restaurants, as part of the ornament of rice-bowls—'Life world without end!'—but perhaps not always recognised.

^d The most detailed accounts are in *Lun Hêng*, ch. 24, tr. Forke (4), vol. 1, p. 335, and in *Fêng Su Thung I*, ch. 2, pp. 15b, 16a. These sources belong to +82 and +175 respectively.

¹ 萬壽無疆

² 劉安

³ 淮南王

⁴ 仙人唐公房碑

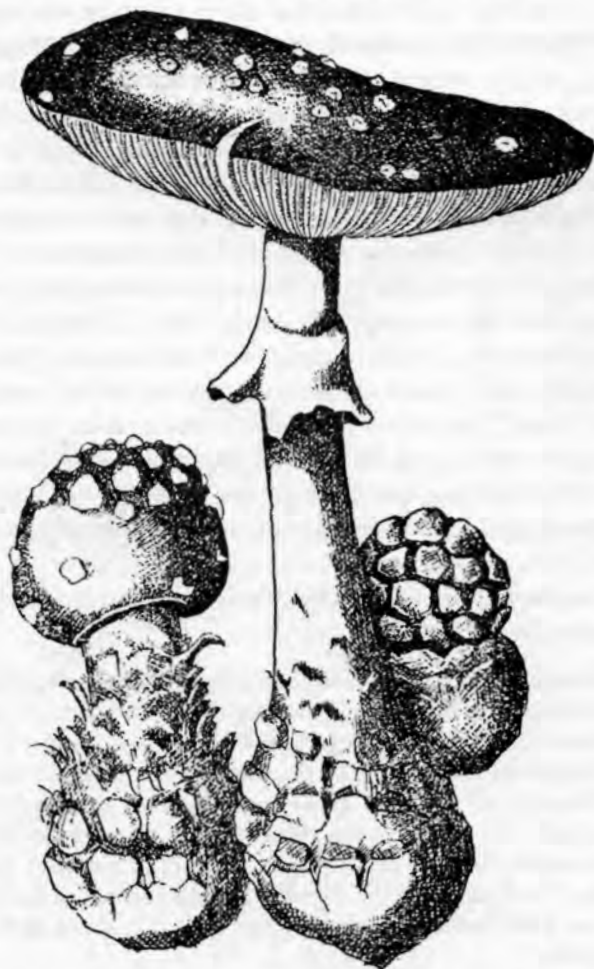


Fig. 1310. *Amanita muscaria*, a hallucinogenic, but not very toxic, mushroom (drawing from Heim (2), fig. 12).

Immortal, Thang Kung-Fang).^a This tells us that in +7 Thang was a minor official in his own district, Chhêngku, a town in the upper Han valley which divides the mountains of Shensi from those of Szechuan. By chance he happened to gain the friendship of a local adept (*chen jen*¹), who accepted him as a disciple and gave him various chemical drugs, one of which made him understand to perfection the language of birds and beasts. Gradually Thang became a *hsien* though continuing his employment; he could summon up any desired scenery in the neighbourhood for those who wished, and magically assembled and killed hordes of rats which had been devouring

^a *CSHK* (Hou Han sect.), ch. 106, pp. 1b, 2a. Yü Ying-Shih (2) was one of the first to see the interest of this text.

¹ 真人

the bedding of the governor and the imperial envoy whom he was showing round the district. In spite of this he fell out with the governor, not being willing to teach him the Tao, so at last the governor ordered his underlings to arrest Thang Kung-Fang and his family as well. Greatly alarmed, he sought help of the adept, who duly proceeded to administer an elixir to Thang's wife and children, saying, 'Now is the time to go.' But they were reluctant to leave their home, so he asked them whether they wished to take it all with them, and they said yes, indeed, that was what they wanted. So the adept daubed the pillars of the house with a chemical preparation (*i yao tu wu chu*¹), giving an elixir also to the domestic animals. Whereupon there quickly arose a great wind and a cloud of darkness which completely carried away Thang Kung-Fang and his family and all their belongings. As the inscription goes on to say, this was much more extraordinary than the achievement of immortality by individual people like Wangtzu Chhiao and Chhih Sung Tzu. In fact one might consider it far beyond the powers of modern chemistry also, were it not for what nuclear physics and chemistry have been able to do in our own time; but alas, it would not be to any earthly paradise that the devilish mushroom-shaped cloud would sweep away Thang Kung-Fang and the family he loved.

By the +2nd century these general tendencies can clearly be seen in the *Thai Phing Ching*. In one place it says:^a

Heaven generates human beings, preparing and bringing the myriad things to fulfilment. Men are born after ten months, and knowing the beginnings and ends of things they can save their generation from calamities and dangers, bringing about an era of great peace and equality. Men of the highest category study the Tao in order to assist the heavenly powers and principalities, they love all life, they amass merit and they endure for ever. Men of the second category study the Tao because they long to bring salvation to those near and dear to them. Men of the lowest category study the Tao simply so that they can slough off their grosser bodily forms. The Tao shines out through the sages; it is not for the unenlightened. He who is able to use it will meet with good fortune; he who is not will hardly gain peace and escape from injuries.

Here then is a conception of material immortality which gives the lowest place to the comparatively selfish pursuit of gaining for oneself the status of a holy immortal. The best seek the common good, the next best that of those around them. Confucian social influence has surely been at work—as elsewhere in the same book, where the practice of leaving one's parents, wife and children to go alone in search of immortality is vigorously condemned. Here perhaps, before Buddhism floods everything with its powerfully ethical other-worldliness, we can leave the question of macrobiotics in relation to ancient Chinese alchemy.

^a Wang Ming ed., p. 724, tr. auct.

¹ 呂藥塗屋柱



Fig. 1313. Ascension of Liu An, Prince of Huai-Nan, in —122.
Lieh Hsien Chhüan Chuan, ch. 2, p. 25a.

(7) THE MISSING ELEMENT; LITURGY AND THE ORIGINS
OF CHINESE ALCHEMY

Now let us leave our cross-roads for the last time, and follow a path that leads off in a highly unexpected direction, through a scented forest in fact, at first penetration very foreign to anything with which we are familiar, but on closer acquaintance much less so. In the consideration of the origins of chemistry the relation between the alchemist's furnace and the hearths and furnaces of the metal-workers (or the kilns of the potters) has been abundantly explored,^a but at least in Chinese culture there was another component which has been almost wholly overlooked—liturgical, not metallurgical. In other words the incense-burner (*hsiang lu*¹) has to be taken into account as one of the ancestors and begetters of the alchemical furnace.^b On page after page of this volume the close connection of Chinese alchemy with Taoist religion and philosophy is emphasised, and the incense-burner so prominent in all temples even today could well have been in ancient times one of the most important inspirations for those who designed to accomplish wonderful changes in natural substances by the instrumentation of fire—China's *philosophi per ignem*. It may well have given much more than inspiration if in the Warring States, Chhin and Han periods, for example, the actual submission of semi-magical substances such as cinnabar, sulphur or the arsenical sulphides, to the fire, took place in these liturgical stoves, with startling results both chemical and physiological. Does not *Pao Phu Tzu* say:

The fact is that the least of the minor cinnabar elixirs is far better than the best things of the plant world. When submitted to the fire all plant substances are burnt to ashes, but cinnabar produces liquid silver (mercury), and this after a whole series of transformations can revert to cinnabar again. That far exceeds what plants can do; hence (such chemicals) can confer longevity and immortality. Only the holy immortals have understood this pattern-principle (*li*²). How infinitely different are they from ordinary people!^c

The olfactory sense, too, has always been one of the most important tools of the chemist, and this would have been very much employed in following the changes caused by the disintegration of plant and animal products in the thurible. Analogies for the generation of science by numinous environments are not too difficult to find, and one might imagine that just as Galileo was stimulated by the pendular swinging of the candelabrum in the cathedral at Pisa, so the curiosity of the Naturalists and adepts

^a As in the memorable book of Eliade (5).

^b This understanding was first expounded by Schipper (3) in 1968 in a discussion of Taoist liturgiology already classical. The liturgies have been the great missing factor in the comprehension of Taoism, though some 30 to 45% of the books in the Taoist Patrology, *Tao Tsang* (according to what criterion one takes), are of a liturgical character. This was quite unappreciated by Wieger (6) in his *catalogue raisonnée*. Only by personal participation in the services, as Dr Schipper and others are now doing, does it become clear how the old texts relate to the forms and ceremonial still used today. Ancient prayers and contemporary action explain each other. Only by getting inside the living tradition as it still survives can one hope to understand and visualise what was thought and done in the +4th century. Cf. Holmes Welch (3); Schipper (2, 4); Saso (1, 2); Yoshioka Yoshitoyo (3).

^c Ch. 4, p. 36, tr. auct., adjuv. Ware (5), p. 72. This passage was justifiably starred in the early paper of Hjordahl (1), p. 221.

¹ 香爐

² 理

of ancient China was awakened by the phenomena of incense-burners. All the more could this be so because, as we shall see, the making of smoke was part of a complex of custom which went far beyond the purely liturgical.

Everyone who has attended a liturgy in a Taoist temple will remember the clouds of incense which accompany the rite.^a These do not emanate from pots in ornamental housings swung on chains as in the West, but from standing stoves or burners (*lu*^{1,2}), generally large and beautiful, often very old, exquisitely made in bronze or cast iron (Fig. 1314), and set up in the court in front of the hall as well as on the altar or holy table^b itself within. On occasion also the incense is burned in a basin or pan on the end of a long handle (*shou lu*³),^c or logs of perfumed wood may be burnt on a hearth in the courtyard (Fig. 1315). Very commonly incense-sticks (*hsiang pang*⁴)^d in thick clusters are stuck into large ornamental metal cauldrons or bowls filled with ash, or trails of incense powder are made to burn slowly on the flat surface of ashes in decorative metal pans, or large conical coils of extruded hardened incense-paste are hung down from the roof (Fig. 1316).^e

The most important object in a Taoist temple is not any statue or scroll-painting of a deity or of the Taoist Trinity (San Chhing⁵), nor the altar itself, but the incense-burner (*chhing lu*⁶) which stands on it. The lay temple-keeper, chosen annually by lot, is the 'furnace-master' (*lu chu*⁷), and his assistant keepers are 'furnace-servers' (*lu hsia*⁸). During the long celebration of one of the great liturgies (*chiao*⁹) the ordained

^a The same is true to some extent of Buddhist liturgical practice, which unquestionably exerted great influence on Taoism in the +2nd and +3rd centuries. But in Buddhism the devotion to perfumes (*gandha*) was perhaps always rather more restrained than the Taoist enthusiasm for the sweet-smelling savour in worship (cf. Eph. v. 1), and hence that of the folk religion which it fostered. On this Ayres (1) has written true words. Whether Nestorian Christianity had any influence on Taoist liturgiology from the +7th century onwards is another matter, not yet adequately looked into.

I myself shall never forget the Taoist mid-autumn festival (Chung Chhiu¹⁰), with its offerings to the Moon Spirit, which I attended at Miao-thai-tzu¹¹ on the Szechuan-Shensi border in September 1945. I recall with gratitude valuable conversations with Abbot Ma Han-Chen¹² on that occasion. And I copied down an inscription in that temple on a note which I still have: *Yüeh pai fêng chhing kao shih lien tan*¹³—'The moon is full white, the breeze at its purest; a refined and enlightened scholar is transmuting the medicine of immortality.'

^b The term altar is justified for the *ching cho*¹⁴ or 'missal table' because the liturgies include offerings of flowers, water, tea, wine, rice, steamed bread and a sweet soup of fruits, though its more continuous function is to support the wooden drum (*mu ku*¹⁵) and the gong (*chhing*¹⁶, *lo*¹⁷) as well as the texts which are chanted (Schipper, 2, 3). There are lights (candles) on the altar, as in Christendom. Many details can be found in the +13th-century liturgical manual of Chin Yün-Chung¹⁸, *Shang-Chhing Ling-Pao Ta Fa*¹⁹ (TT 1204-6).

^c These are very common in the Chhien-fo-tung cave-temple frescoes at Tunhuang (cf. Fig. 1317). A hand-held burner of this kind is still essential in one phase of the *chiao* liturgy (p. 130). The Morohashi encyclopaedia (vol. 9, p. 967) gives an illustration of one form of it used in the Han, a shallow bronze pan with lid, feet and handle; naming it *hsün lu*²⁰ (cf. p. 133 below). Von Lecoq figures (2), pp. 167 ff. and pl. 48, an actual bronze example found in a grave at Tumsuq (between Kashgar and Aksu).

^d These are the 'joss-sticks' known nowadays all over the world. The word is of course a mock borrowing from the Chinese—nothing but the Portuguese word *deus* reaching us through pidgin—or so says Hobson-Jobson.

^e N. Lewis (1); Holtorf (1).

¹ 爐

² 爐

³ 手爐

⁴ 香棒

⁵ 三清

⁶ 清爐

⁷ 爐主

⁸ 爐下

⁹ 醮

¹⁰ 中秋

¹¹ 廟台子

¹² 馬含真

¹³ 月白風清高士鍊丹

¹⁴ 經棹

¹⁵ 木鼓

¹⁶ 鑿

¹⁷ 鑼

¹⁸ 金允中

¹⁹ 上清靈寶大法

²⁰ 薰爐

priest (Tao Shih,¹ Tao Chang,² Chi Chiu,³ Kao Kung Fa Shih⁴)^a stands, as Chai Kuan⁵ (Numinous Official),^b in front of the altar, in a heavily embroidered cope with sleeves (*Tao phao*⁶), facing north and flanked on each side, as it were, by two deacons and two subdeacons in black robes (*hai chhing*⁷). On his left is the principal cantor (*tu Chiang*⁸) who manages the drum, on his right the assistant cantor (*fu Chiang*⁹) who strikes the gong; beyond them respectively to the left the thurifer (*chih Hsiang*¹⁰) in charge of the incense, and to the right the gladiator-aspergarius (*yin Pan*¹¹), leader of the processions and perambulations of the sacred enclosure (*than*¹²), the sanctuary.^c

Every liturgy starts with the lighting of the incense-burner (*fa lu*¹³), and every liturgy ends with a return to it (*fu lu*¹⁴). As the liturgical texts repeatedly say: 'Whether within or beyond the Three Worlds the Tao alone is worthy of worship; among the ten thousand rites the burning of incense has the primacy (*San chieh nei wai wei Tao tu tsun; wan fa chih chung shao Hsiang wei shou*)¹⁵.'^d Then after the symbolic sending of memorials to the heavenly court, accompanied by hosts of angels, spiritual officials and archaici, a diabolic interruption is mimed by an acolyte who, representing the forces of evil, snatches away the hand-held incense-burner. To the accompaniment of an orchestral crescendo and a burst of fire-crackers, however, he is caught by the sacred ministers, imprisoned in the sanctuary, and the incense-burner recovered for the service of the Tao. Afterwards follows the sacrifice of food and drink, flowers and tea, when the Holy Ones are invited to descend and partake as great guests with the community on whose behalf the liturgy is performed. The priest chants: 'This day, burning incense, I seek refuge in the treasures of the Tao so that having obtained it I may gain eternal life, in perfect union with it. Now let us sing, in company with our merciful Father, as closely knit as flesh and bone...'^e And there follows the hymn which begins: 'I rejoice in the law (of the Tao) as if it were my lover.'^f Lastly comes the prayer at the *fu lu*:

O Official Envoys of the incense, Lords of the Dragon and Tiger to the left and right, Golden Girls and Boys attending upon the fragrance, and all Divine Beings, cause that at this place where I have today conducted an audience the divine mushroom of immortality, cinnabar and jade green, may spontaneously grow from out of the golden liquor, and that the host of Perfected Immortals may meet in unity at this ardent incense-burner. May the

^a Respectively—Taoist scholar, Presbyter or Elder of the Tao, Libationer (an ancient Han title), and Highly Accomplished Teacher of the Law (a partial borrowing from Buddhism).

^b Or more correctly, Official of the Fasting Pavilion.

^c He it is who carries the sword of the spirit and the sanctified water.

^d Schipper (3).

^e On the Taoist Trinity see Vol. 2, p. 158.

^f These formulations go back word for word to the early 5th century, as appears from the liturgical writings of Lu Hsiu-Ching¹⁶, who might be called the Venantius Fortunatus of China. See his *Thai Shang Tung Hsuan Ling-Pao Shou Tu I*¹⁷ (Formulae for the Reception of Salvation...), TT 524, dating from about +450. Tr. Schipper (3), mod. auct.

¹ 道士

² 道長

³ 祭酒

⁴ 高功法師

⁵ 齋官

⁶ 道袍

⁷ 海青

⁸ 都講

⁹ 副講

¹⁰ 值香

¹¹ 引班

¹² 壇

¹³ 發爐

¹⁴ 復爐

¹⁵ 三界內外惟道獨尊，萬法之中燒香爲首

¹⁶ 陸修靜

¹⁷ 太上洞玄靈寶授度儀

Immortal Youths and Jade Girls of the Ten Directions attend upon and protect this incense, and transfer swiftly all that I have said before the heavenly throne of the Supremely Honoured . . . Jade Emperor Above.^a

Here the angelic hosts of Taoism are very real, and the alchemical nuances clearly manifested.

So much for the public ceremonies of the faith. But it is always to be remembered that there were many private rites available to, or even incumbent upon, the actual elixir alchemist himself. So far very little attention has been given to these, though their study might well be useful for comparative religion. We have occasion to refer to them in this volume from time to time,^b but space could not allow a long discussion. Take, for instance, a tractate such as the *Shang-Chhing Chiu Chen Chung Ching Nei Chüeh*,¹ ascribed to semi-legendary authorship perhaps of the +4th century, but more probably about the +6th, if it is not a text of the T'ang period itself. Here one finds directions for the liturgical worship which should precede the taking of any cinnabar or mineral elixirs, or any procedures in their preparation—'without the rite', it says, 'no chemical medicine will do any good'. Altars are set up (Fig. 1318) with offerings of wine and jujube-dates, then to the inevitable accompaniment of incense (and after a confession of sins) libations are poured to gods such as Thai-I² (the Great Unity)^c and invocations made to other great spiritual beings, e.g. Su Nü³ (the Immaculate Girl).^d One rite involves a solemn ritual dance by the teacher and a disciple.^e The tractate contains instructions about fortunate, unfortunate and prohibited days, as also about the proper apotropaic talismans (*fu*⁴) to hang up around the oratory. All this is reminiscent of the conviction of later European quasi-psychological alchemists that the workshop must be also a place of prayer; *laboratorium est oratorium*—as we see in the often-reproduced picture from Khunrath's *Amphitheatrum Sapientiae Aeternae* (+1609) or the music for hymns or madrigals in Michael Maier's *Atalanta Fugiens* (1618).^f

The most ancient descriptions of the Taoist oratory for meditation and worship, the 'Pure Chamber' or 'Calm Room' (*ching*,⁵ *ching shih*⁶ or *shê*⁷, *chhing shih*⁸), represent it as almost empty except for an incense-burner.^g Here took place the *chhao chen*⁹ or 'audiences with the Absolute', as the phrase has been felicitously if somewhat anachronistically translated. There has been a certain tendency to believe that before the

^a The text still used is exactly that found in *T'eng Chen Yin Chüeh*,¹⁰ ch. 3, p. 10a, therefore dating from c. +360. Tr. Schipper (3), mod. auct.

^b Cf. Vol. 5, pt. 3 below.

^c See also Vol. 3, pp. 77, 260 and pt. 3 below.

^d Cf. Vol. 5, pt. 5 below and meanwhile Vol. 2, pp. 147ff.

^e This is called 'Steaming the *chü-shêng*¹¹' (an ancient cereal of uncertain identification but associated with immortality). See pt. 3 and Sect. 38 in Vol. 6; also Waley (14). Another ceremony bears the rubric 'Method of steaming hemp (*hu ma*¹²) according to Su Nü'; this may be significant in the light of later evidence (p. 150 below), but the details about the hemp have dropped out.

^f Tenney Davis (1) and Read (1), pp. 251ff.; see also Montgomery (1), p. 81. The most recent study of Michael Maier is that of de Jong (1). Cf. Vol. 5, pt. 5.

^g *T'eng Chen Yin Chüeh*, ch. 3, p. 7b, comm., late +5th cent. On the oratories see further R. Stein (5).

¹ 上清九真中經內訣

² 太一

³ 素女

⁴ 符

⁵ 靖

⁶ 靜室

⁷ 舍

⁸ 清室

⁹ 朝真

¹⁰ 登真隱訣

¹¹ 苡勝

¹² 胡麻

上清九真中經內訣 第四



Fig. 1318. Alchemical altar with offerings, from the *Shang-Chhing Chiu Chen Chung Ching Nei Chüeh* (TT901), p. 4a, b.

+ 2nd or + 3rd century incense was not much used in China,^a but apart from the great disinclination we would naturally have to believe that the rites of Chhin Shih Huang Ti and Han Wu Ti were not hazy with it, there is positive evidence of its use at least as far back as the Chhin or late Chou period. Texts of the earlier Chou do not, it is true, supply good examples of the burning of incense even at sacrifices, and when the words *hsiang*¹ or *hsing*² occur in the *Shih Ching*^b or the *Tso Chuan*^c they generally refer without doubt to the sweet or savoury odours of the sacrificial food and wine, though in one case it is prophesied of a young man that he will be 'like an orchid, the fragrance

^a As in Fan Hsing-Chun (6), p. 23, for instance. Cf. *Ko Ku Yao Lun*, p. 7a, tr. David (3), p. 12.

^b See e.g. Legge (8), vol. 2, pp. 472, 479, 602-3.

^c See e.g. Couvreur (1), vol. 1, pp. 86, 255.

¹ 香

² 馨

of the State'.^a Some importance may nevertheless attach to the fact that as the ancient philologists got to work, the word *hsiang*¹ attained (and kept to the present day) the status of a full radical,^b though itself composed of two much commoner ones into which it could have been split. By the -4th century, however, the situation becomes very different.

Already at a previous point in this survey, in connection with the origins of relief maps, we had occasion to speak of the 'hill-censers' or Vast Mountain Stoves (*po shan hsiang lu*²) which, as we know from archaeological as well as textual evidence, were quite common in the Han.^c Most probably they were first introduced in the late Warring States period. Made in metal or pottery^d they resembled a realistic mountain with its foothills, representing either Mt Khun-Lun (equivalent to Mt Meru in Indian cosmology) or the magic islands of Phêng-Lai in the Eastern Sea; and they were fretted with holes through which the incense smoke escaped. Mortuary jars and other objects were made in imitation of them. One *po shan lu* inscription has come down to us from the pen of Liu Hsiang³ himself (c. -40).^e

I value this perfect utensil, lofty and steep as a mountain! Its top is like Hua Shan yet its foot is a bronze plate. It contains rare perfumes, red flames and green smoke; densely ornamented are its sides, and its summit joins azure heaven. A myriad animals are depicted on it. Ah, from its sides I can see even further than Li Lou.^f

We may also remember the mechanician Ting Huan,⁵ who about +180 invented 'nine-storied hill censers' (*chiu tshêng po shan hsiang lu*⁶) with queer birds and strange animals which moved 'by themselves' in the ascending hot air current.^g The antiquity of incense in the Han is also attested, not only by Ting's successful 'censer among the bedclothes' (*pei chung hsiang lu*⁷),^h which had gimbals, but still more by the further evidence that these 'censing baskets' went much further back, indeed to the time of Ssuma Hsiang-Ju,⁸ c. -140. The hill-censers of the Han handed down their mountain-peak form to the covers of some of the hand-held incense-burners (*shou lu*⁹) of later centuries, as in the Tunhuang frescoes.

Many of these belong of course to the Thang period, and the customs of this time were typical of all the Chinese Middle Ages. In that world, as Schafer has well said,¹ there was little clear-cut distinction between incense, aromatics, perfumes, drugs, flavourings, colouring matters and spices. Pleasant fragrances were used on the body,

^a This in -605. Couvreur (1), vol. 1, p. 578.

^b I.e. one of the 214 that have been accepted since the +17th century (cf. Vol. 1, pp. 30ff., Vol. 6, pt. 1).

^c Vol. 3, p. 581. One of the finest examples known is seen in Fig. 1336.

^d Hence the form of the character with the ceramic radical, *lu*,¹⁰ found even in the liturgical texts sometimes.

^e Cit. Schipper (3), mod. auct.

^f Li Lou was a legendary long-sighter, who could see more than a hundred *li*. He occurs in *Chuang Tzu*; cf. Mayers (1), no. 358.

^g See Vol. 4, pt. 1, p. 123.

^h See Vol. 4, pt. 2, p. 233.

¹ (13), pp. 155ff.

¹ 香

² 博山香爐

³ 劉向

⁴ 離婁

⁵ 丁毅

⁶ 九層博山香爐

⁷ 被中香爐

⁸ 司馬相如

⁹ 手爐

¹⁰ 爐

for the bath, and as sachets in the dress. Whatever would give a fragrance on burning was made use of as a sustenance of the spirit, a powerful element in numinous experience, something attracting the auspicious and the good, something pleasing to deities and lovers, something symbolic of the sincere worship of the pure in heart. So far did this go that incense became an important feature of all State business in the imperial presence, not because the emperor was himself a god, as in old Rome, not at all, but because as cosmic priest of the whole people there was a sacredness in his every action, and his incense was like the dalmatic of the Byzantine *basileus pantokratōr*. Even in examining civil service candidates for office, the use of incense put both officials and students in the right frame of mind. Nor should the important influence of Buddhism in these developments be overlooked, for the very Sanskrit word for temple (*śrī*) was *gandhakūṭī*, the house of incense.^a

(i) *Incense, prototypal reactant*

It would hardly be satisfactory to drop the subject at this point because our curiosity has been awakened concerning the nature of the fragrant gums and woods which the Chinese used in Taoist and Buddhist temple worship.^b What these were it is quite possible to find out, though the pursuit of the subject in detail would involve us in some rather complex historical and botanical questions not yet finally cleared up by scholars;^c that we must avoid. Before looking into this, however, a few words are necessary about the ancient and medieval Chinese literature on incense, much of which still exists, though not so far systematically analysed. When Chhen Ching² wrote his *Hsiang Phu*³ (Treatise on Perfumes and Aromatic Substances) in the +12th or +13th century he listed eleven previous monographs on the subject, but of all these only the *Hsiang Phu*³ of Hung Chhu,⁴ written about +1115, still exists in complete form.^d Extensive quotations from Shen Li's⁵ *Hsiang Phu*³ of +1074 are however available;^e this was a particularly important book on account of its description of the use of incense in time-keeping, a matter to which we shall presently return. The Southern Sung also saw Yeh Thing-Kuei's⁶ *Hsiang Lu*⁷ (Catalogue of Incense) produced in +1151;^f and under the Yuan a provincial professor, Hsiung Phêng-Lai,⁸ wrote yet another *Hsiang Phu*³

^a In Chinese, *hsiang shih*,⁹ if not transliterated syllabically in various ways.

^b At least from the Sung onwards incense was also used in the Confucian temple ceremonies, especially on the eve of the sage's birthday. Cf. Vol. 2, p. 32.

^c One of the most productive modern specialists on incense, perfumes and aromatics in East and South-east Asia is Yamada Kentaro, whose books (1, 2, 3, 4) also cover the trade with Western Asia and Europe. For the Thang period a mass of information has been collected by Schafer (13), and to a lesser extent (16), while for the Sung and its trade we have a remarkable book by Lin Thien-Wei (1). Naturally in the translation of the *Chu Fan Chih* by Hirth & Rockhill (1) there is much about the trade in perfumes and incense, with useful references to the *Ling Wai Tai Ta* and other books of the age on southern and foreign products. For medieval Japan the studies of Aoki Masaru (1) contain much of interest. Cf. also Casal (2).

^d Under each of its 43 entries it gives a brief description, historical notes, origin, whether imported or indigenous, and uses, including medicinal.

^e There are translations in Bedini (5). Cf. *Lei Shuo*, ch. 59, pp. 12a ff., 14b ff.

^f Wada Hisanori (1) has done a special study of him and his book.

¹ 寺

² 陳敬

³ 香譜

⁴ 洪芻

⁵ 沈立

⁶ 葉廷珪

⁷ 香錄

⁸ 熊朋來

⁹ 香室

(+1322). In the Ming there were quite a number of works, some short, such as the *Hsiang Chien*,¹ or Notes, of Thu Lung² (d. +1577), others long and elaborate like the *Hsiang Chhêng*³ (Records of Incense)^a by Chou Chia-Chou,⁴ between +1618 and +1641, or the *Hsiang Kuo*⁵ of Mao Chin,⁶ not far removed from it in time.^b This may suffice to show that Chinese scholars through the centuries were very interested in the natural history of fragrances, whether combustible or otherwise, and did not disdain to write about them.

Actually there were tractates on the blending of incense long before the systematic monographs on aromatics individually described. Of these the most venerable is a fragment of the +1st or +2nd century from a *Han Kung Hsiang Fang*⁷ (On the Blending of Perfumes in the Palaces of the Han) containing a commentary by none other than the great scholar Chêng Hsüan⁸ (+127 to +200). Preserved by Chang Pang-Chi,⁹ as the result of a lucky manuscript find, in his *Mo Chuang Man Lu*¹⁰ of c. +1131,^c it mentions aloes (garroo), putchuk (costus), clove, Baros camphor, and musk;^d wild honey and rice congee being used as vehicles for the paste.^e How distinguished the subject was is further shown by another work, long lost now too, the *Shang Hsiang Fang*¹¹ (Formularies of Imperial Incense Blends), written by the historian of the *Hou Han Shu* itself, Fan Yeh¹² (+398 to +445). Nor did an emperor of this same dynasty hesitate to write on the matter in person, as witness the *Hsiang Fang*¹³ of Liu Yü,¹⁴ Ming Ti of the Liu Sung (r. +465 to +473); unfortunately his text has not survived. Lastly one should give the Buddhists their share by mentioning a lost work of uncertain date evidently due to that milieu, the *Lung-Shu Phu-Sa Ho Hsiang Fang*¹⁵ (Incense Blends of the Bodhisattva Nāgārjuna).^f

There is of course also much to be found on incense and perfumes in the encyclopaedias. The *Thai-Phing Yü Lan* of +983, for example, discusses forty-two of them. Occasional literary pieces may be important, such as the essay by Ting Wei¹⁶ (d. +1034) entitled *Thien Hsiang Chuan*.¹⁷ And the relevant sections of the many books on miscellaneous subjects may contain material of much interest, as in the case of the *Chhing I Lu*¹⁸ (Records of the Unworldly and the Strange), by Thao Ku,¹⁹ c. +950, where many aromatics are recorded, and stories about them.^g Or half a millennium later there is the

^a Cf. Swingle (11), p. 266.

^b At this period Li Shih-Chen lists and describes fifty-six kinds of plant aromatics (*fang tshao*²⁰) in *PTKM*, ch. 14, though they include some drugs and ornamental plants with strong scents not used in incense; and also thirty-five kinds of aromatic trees and woods (*hsiang mu*²¹) in *PTKM*, ch. 34.

^c Ch. 2, pp. 17b, 18a.

^d For explanations of all these, see pp. 136-44 below.

^e It is directed that the mixing should not be done in vessels of copper or iron. The formula is reproduced in *SIC*, pp. 792-3. The pasty character of the mix before drying accounts for the title of another lost book in the Sui bibliography, *Tsa Hsiang Kao Fang*.²²

^f This personage (if indeed there was only one) has alchemical connections, and we discuss him (or them) elsewhere, pts. 3 and 4 below.

^g Ch. 2, pp. 58a-62b.

¹ 香淺

² 屠薩

³ 香乘

⁴ 周嘉胄

⁵ 香國

⁶ 毛晉

⁷ 漢宮香方

⁸ 鄭玄

⁹ 張邦基

¹⁰ 墨莊漫錄

¹¹ 上香方

¹² 范曄

¹³ 香方

¹⁴ 劉或

¹⁵ 清異錄

¹⁶ 龍樹菩薩和香方

¹⁷ 丁謂

¹⁸ 天香傳

¹⁹ 清異錄

²⁰ 陶穀

²¹ 芳草

²² 香木

²³ 雜香膏方

*Chiao Chhuang Chiu Lu*¹ (Nine Dissertations from the Desk at the Banana-Grove Window), by Hsiung Yuan-Pien,² the last one of which is devoted to the subject of religious osphristics. The +10th-century writings just mentioned were only a little later than the period of activity of two of the most remarkable perfume-merchants in Chinese history, Li Hsün³ and his younger brother Li Hsien.⁴ Of a family originally Persian and resident at the court of Shu, independent Szechuan, the elder was a notable poet and naturalist, the writer of the *Hai Yao Pên Tshao*⁵ (Pharmaceutical Natural History of Overseas Drugs and Sea Products) often afterwards quoted. The younger was an alchemist and herbalist, known for his expertise in perfumes and probably their distillation.^a

What then were the most important aromatic substances which the Chinese had, or got, to form the basis of their clouds of incense? Though the list could easily be enlarged to include many lesser known products, we have assembled a sufficient number, with their principal Chinese names, in Table 94. Twelve substances (nine of vegetable and three of animal origin) were fully indigenous and could have been articles of trade at the courts of the feudal princes before the First Unification. Forming the core of this autochthonous group were cassia (cinnamon),^b *chang* camphor,^c sweet basil,^d citronella,^e spikenard,^f a form of putchuk (costus),^g a form of anise,^h together with terebinthⁱ and gardenia.^j It is remarkable that as many as three

^a We shall have more to say of this family in Vol. 5, pt. 3 and in Vol. 6, pt. 1.

^b From *Cinnamomum Cassia* = *aromaticum* (= *Laurus cinnamomum*), *kuei*⁶ (R 494; CC 1318). More will be said of this, and many other of the plants mentioned here, in Sect. 38 on botany in Vol. 6, pt. 1.

^c *Chang nao*⁷ from *Cinnamomum camphora*, the *chang*⁷ tree (R 492, 493; CC 1317). All three of the camphors mentioned here are chemically different; this is dextro-camphor. Cf. Hemsley (1); Julien & Champion (1), pp. 229ff.

^d From *Ocimum basilicum*, *lo lē*⁸ (R 134). This name was not so famous as *Ling-ling hsiang*,⁹ on which the best opinion is that it was an especially fragrant variety of *O. basilicum*; or possibly *O. sanctum*, widespread in tropical Asia, if that had a relatively cold-resistant variety. On the genus see Burkill (1), vol. 2, pp. 1570ff.

^e A *mao hsiang*,¹⁰ from a sweet grass, *Cymbopogon* (= *Andropogon*) *nardus* (R 729; CC 1993; Burkill (1), vol. 1, p. 727). See Fig. 1341b.

^f *Nardostachys jatamansi* of the Valerianaceae, giving *kan sung hsiang*¹¹ (R 71).

^g See note on pp. 140-1.

^h 'True' aniseed comes from the umbelliferous *Pimpinella anisum*, and anise oil was distilled from it in Mediterranean regions since the early Middle Ages or late antiquity (cf. Burkill (1), vol. 2, pp. 1728ff.). China has a related species, *Pimpinella calycina*, which gives 'spider perfume', *chih chu hsiang*¹² (R 229), but we do not know from what date this was used. Much more important there was the genus *Illicium* of the Magnoliaceae. One prominent species of this is very poisonous, *Illicium religiosum* (= *anisatum*), the 'bastard' or Japanese anise, *shikimi* in that language, *mang tshao*¹³ in Chinese (R 505; CC 1339), known and used as an insecticide and fish poison ever since the early Han period (-2nd century) or earlier. But another, *I. verum*, the 'star' or Chinese anise, *pa chio hui hsiang*¹⁴ (R 506; cf. Burkill (1), vol. 2, pp. 1224ff.) can be used as perfume and food flavouring.

ⁱ A gum resin from *Pistacia terebinthus* (= *P. khinjuk*), *tu nou hsiang*¹⁵ (R 313; CC 839; Burkill (1), vol. 2, p. 1756). Cf. R 262.

^j *Chih tsu*¹⁶ (or *fan chih tsu*,¹⁷ when it came from abroad or from the Western tribal peoples), *Gardenia florida* (R 82; CC 221, 222).

¹ 蕉窗九錄

² 項元汴

³ 李珣

⁴ 李玟

⁵ 海藥本草

⁶ 桂

⁷ 樟腦

⁸ 羅勒

⁹ 零陵香

¹⁰ 茅香

¹¹ 甘松香

¹² 蜘蛛香

¹³ 菲草

¹⁴ 八角茴香

¹⁵ 駕轎香

¹⁶ 梔子

¹⁷ 薝蔔子

Table 94. *Constituents of incense, and other aromatics*

				China indigenous		South- east and South Asia imported	Western Asia Europe, Africa, imported
				early	later		
	aloes-wood (garroo)	<i>chhen hsiang</i>	沉香	—	*	*	—
A	amberggris	<i>lung hsien hs.</i>	龍涎香	—	—	*	—
	anise	<i>hui hs.</i>	茴香	*	*	—	*
	basil	<i>lo lê hs.</i>	羅勒香	*	*	—	—
	bdellium (earlier)	<i>an hsi hs.</i>	安息香	—	—	—	*
	benzoin (later)	<i>an hsi hs.</i>	安息香	—	—	*	—
	Baros camphor (l-borneol)	<i>lung nao hs.</i>	龍腦香	—	—	*	—
	chang camphor (d-camphor)	<i>chang nao hs.</i>	樟腦香	*	*	—	—
	sëmbong camphor (l-camphor)	<i>ai na hs.</i>	艾納香	—	*	*	—
	cassia (cinnamon)	<i>kuei hs.</i>	桂香	*	*	—	—
	citronella	<i>mao hs.</i>	茅香	*	*	—	—
A	civet	<i>ling mao hs.</i>	靈貓香	*	*	—	—
	clove	<i>ting hs.</i>	丁香	—	—	*	—
	costus [see putchuk]						
	elemi (brea)	<i>tan thang hs.</i>	薈糖香	—	*	—	—
	frankincense	<i>ju hs.</i>	乳香	—	—	*	*
	galbanum	<i>phi chhi hs.</i>	訥齊香	—	—	—	* briefly
	gardenia	<i>chih tzu hs.</i>	梔子香	*	*	—	—
	garroo [see aloes]						
	jasmine (<i>offic.</i>)	<i>yeh hsi ming hs.</i>	耶悉茗香	*	*	—	*
	jasmine (<i>Sambac</i>)	<i>mo li hua hs.</i>	茉莉花香	*	*	*	—
	laka	<i>tzu thêng hs.</i>	紫藤香	—	—	*	—
	liquidambar (later)	<i>su ho hs.</i>	蘇合香	—	*	*	—
A	musk	<i>shê hs.</i>	麝香	*	*	—	*
	myrrh	<i>mu yao hs.</i>	沒藥香	—	—	—	—
A	onycha	<i>chia hs.</i>	甲香	*	*	—	—
	patchouli	<i>huo hs.</i>	藿香	—	*	*	—
	putchuk (costus)	<i>kuang mu hs.</i>	廣木香	—	*	*	*
	rue	<i>yün hs.</i>	芸香	*	*	—	—
	sandal	<i>than hs.</i>	檀香	—	—	*	—
	spikenard	<i>kan sung hs.</i>	甘松香	*	*	—	—
	storax (earlier)	<i>su ho hs.</i>	蘇合香	—	—	—	*
	terebinth	<i>tu nou hs.</i>	篤耨香	*	*	*	—
	walnut-gum	<i>pi li hs.</i>	必梨	*	*	—	—

A denotes an animal product.

important animal perfumes were early discovered and used in China, musk^a and civet^b from mammals, and the very curious onycha^c from a mollusc. After the Chhin

^a This is a dried secretion of the preputial follicles of the musk deer, *shê*,¹ hence called *shê chhi hsiang*² (R 369). *Moschus moschiferus* had a wide distribution all over the Chinese culture-area and its fringes, so it is not surprising that the perfume was known and used from the beginning of the Han, at least, onwards, as is evidenced by its inclusion in the *Shen Nung Pên Tshao Ching* (Mori ed., ch. 1, p. 45). For a general survey see Bovill (1), who says that musk is particularly valued by perfumers because it gives a special tenacity and subtlety to other aromatic substances which may be mixed with it, and also because it has an extraordinary power of wide diffusion. Cibot (16) gave the classical Jesuit relation of it in +1779. For a recent account of the chemistry of musk see Lederer (1).

^b A dried secretion of the scrotum from the civet 'cat', in China *Viverra zibetha* (R 370), *ling mao*,³ hence *mao hsiang*⁴ or *li hsiang*.⁵ On civet also see Bovill (1). It has never been so valuable as musk, its

¹ 麝² 麝香³ 靈貓⁴ 貓香⁵ 狸香

and Han, six more indigenous aromatics similar to some of those imported were found and made use of, or else the plant itself was introduced and acclimatised. Here the most obvious case of the second type is that of the two jasmines,^a but gradually even so exotic an incense as aloes-wood (garroo)^b was found to be growing in Hainan, while after the colonisation of the south and of Formosa liquidambar^c became available on Chinese territory. The history of some perfumes still presents much uncertainty; thus while we place patchouli^d and *sěmbong* camphor^e mainly among the aromatics imported from South-east Asia (Nan Hai^f) there are reasons for thinking that the same or another plant produced the same or a similar product within China also, and it is then a matter for the always intricate history of commerce to decide between import and internal production at different periods. It is hard also to know where to draw the line in ancient times between China and Indo-China, but certainly by the Thang the dark sugary oleoresin (elemi or breas)^f of the *Canarium* genus, smelling of lemon and turpentine, was harvested in Kuangtung and sent up to enrich

properties being less pronounced. The European supply came mainly from African *V. civetta* exported from Abyssinia and western regions of that continent. By the +13th century some of this was reaching China also. Hirth & Rockhill (1), pp. 234-5, who discuss this, mention also two substitutes long used by the Chinese.

^c Onycha comes from the operculum of gastropod molluscan species found on the shores of China. *Eburna japonica* (R236, 237) is the main species, usually designated *hai lo*,² though this is a generic name for a number of kinds of whelks. More specific was the name of the perfume itself, *chia hsiang*³ (scale or plate aromatic), and another term which indicated a somewhat complex preparation, *chia chien*⁴ (scale or plate decoction). The opercula were extracted first several times with various solutions, finally ground and dried. Other species, such as the brackish-water *Potamides micropterus*, were also used. We reproduce here the illustration from the *Chêng Lei Pên Tshao* (+1249 ed.), ch. 22 (p. 455.2), as Fig. 1319.

^a Acclimatisation seems to have taken place in South China in Han times, but the perfume probably continued to be brought in trade, and the two main species had Chinese names which betray foreign origins. *Jasminum officinale* (= *grandiflorum*) was called *yeh hsi ming*⁵ from Ar. *yāsmīn*, but it also acquired the purely Chinese name of *su hsiang*⁶ (R180; CC455). *Jasminum Sambac*, on the other hand, was named *mo li hua*⁷ after the Skr. *mallikā* (R181; CC457). We shall discuss the jasmines more fully in Sect. 38.

^b See note on p. 141. This has nothing to do with 'bitter aloes', the concreted leaf-juice of the succulent mucilaginous Liliaceous plant *Aloe Perryi* that grows on Socotra Island and in neighbouring Somaliland (R674; Burkill (1), vol. 1, p. 108). This is a drug, tonic, aperient, cathartic, an emmenagogue and cholagogue. Exported to China, it was known as *lu hui*⁸ (cf. Pers. *alwā*), appearing first in the *Khai-Pao Pên Tshao* of +970. Chao Ju-Kua in +1225 gave a description of the method of its preparation, and said that Arab traders took it to Sumatra (cf. Hirth & Rockhill tr., pp. 4, 61, 131, 225). In the Ming and later there may have been some confusion with the tannin-rich gum catechu (*kath*) from *Acacia catechu* (Burkill (1), vol. 1, p. 15), to which the names *nu hui*⁹, *no hui*¹⁰ and *hsiang tan*¹¹ more properly apply.

^c See fn. c on p. 142.

^d See fn. h on p. 142.

^e See fn. f on p. 142.

^f Elemis or breas are oleoresins of trees of the *Canarium* and other genera. *Canarium album* (= *sinense*) is the 'Chinese olive', *kan lan*,¹² and its oil was used in the middle ages for caulking ships and boats (R337; CC889). The aromatic species chiefly used is different, however, *Canarium copaliferum* (= *commune*), which always flourished in South China (Burkill (1), vol. 1, pp. 428ff.; Schafer (13), p. 165, (16), p. 197). Since the oleoresins of this kind have in general a granular or sugary character, that most widely used in China was called *tan thang hsiang*.¹³

¹ 南海

² 海藻

³ 甲香

⁴ 甲煎

⁵ 耶悉茗

⁶ 素馨

⁷ 茉莉花

⁸ 蘆薈

⁹ 奴會

¹⁰ 訥會

¹¹ 象胆

¹² 橄欖

¹³ 蘆糖香

景主久瘡大鼈甲丸中
使之以其主寒熱也

千金方

治產後小便不利鼠婦七枚
一味熬為屑作一服酒調下

衍義曰

鼠婦此濕生蟲也多足其色如蚓背有橫紋蹙起大
者長三四分在處有之輒焚及下濕處多用處絕少

螢火味辛微溫無毒主明目小兒火瘡傷熱氣蠱毒

鬼疰通神精一名夜光一名放光一名熠切以入燿切以灼名

即炤音照生階地池澤七月七日取陰乾陶隱居云此是腐草及爛竹根

所化初猶未如蟲腹下已有光數日便變而能飛方術家捕取內酒中令死乃乾之俗藥用之亦稀目禹錫等謹按蜀本注云爾雅云螢

火即炤注曰夜飛腹下有火按此蟲是朽草所化也呂氏春秋云腐草化為螢是也藥性論云螢火亦可單用治青盲

衍義曰螢常在大暑前後飛出是得大火之氣而化故如此明照也今人用者少月令雖曰腐草所化然非陰燃處終無

泉州甲香



Fig. 1319. The perfumed onycha mollusc, from *Chêng Lei Pên Tshao* (+1249), ch. 22, p. 34a (p. 455.2). The relevant text follows to the left, and the main entry on the page here shown concerns fire-flies.

the incense of all the temples of the capital and the north. This completes the six additional aromatics mentioned above.^a

The next group is that of the incense and perfumes which reached China from the Middle East and the Mediterranean, probably from the time of the first trade contacts in the -2nd century (overland) and the -1st century (by sea).^b Of these we count again six, apart from one which came late and infrequently. Frankincense^c must take pride of place, with myrrh^d its close coadjutor,^e but the solid form of storax,^f and bdellium,^g which took the name of Arsacid Persia in Chinese, were also very famous. Further to be mentioned are the West Asian types of putchuk (costus)^h and of

^a Two quasi-perfumes used especially for fumigating libraries against bookworms, rue and 'walnut-gum', will be mentioned presently (p. 148). Other pleasant fragrances capable of contributing to incense or perfumes which have been available in China from very early times are *pai chih*,¹ *Angelica anomala* (R207; Stuart (1), p. 41), which gave rise as *fang hsiang*² to a word very common in given names; and *pai fang hsiang*³ or *pai mao hsiang*⁴ (if our identification is right), i.e. vanilla grass or *Hierochloa borealis* (R740; Stuart (1), p. 207), something like citronella, and resembling the fragrant grasses used in the church rush-bearing processions of English folk usage (cf. Burton, 1). See Fig. 1341b.

^b Cf. Vol. 1, pp. 191, 197; Vol. 4, pt. 3, pp. 443-4. On the converse traffic westbound something could be said if space permitted, especially after the opening of the Old Silk Road about -110. Cinnamon was known from Herodotus' time onwards (cf. Innes Miller (1), pp. 42ff.), and East Indian pepper imported by the Roman Empire; but musk seems not to be mentioned till the +4th century, and camphor not till even later. When the spice trade began in earnest it was of course with South-east Asia, first through the Arabs and then the Portuguese, not with China directly (cf. Vol. 4, pt. 3, pp. 519ff.).

^c This was the gum resin also called *olibanum* (Lat.) and *al-lubān* (Ar.), derived from the trees *Boswelli Carteri* (= *sacra*) of the Hadhramaut and *B. Frereana* of Somaliland (R336; CC888). In Chinese it was called *ju hsiang*⁵ (teat or mammillary aromatic) because of the forms produced by its candlewax-like character. Another name, very evocative (cf. pp. 89, 90 above), was *fan hun hsiang*⁶ (the 'calling-back-the-soul' aromatic). Two other species, *B. serrata* and *B. glabra*, native to India, gave the similar, if inferior, gum called *kunduruka*, used to adulterate Arabian and African frankincense. According to Chhen Jung (1), p. 596, *Boswellia* species are now acclimatised in South China. On the ancient trade in frankincense from Arabic Felix see van Beek (1); Innes Miller (1); Loewe (7).

^d Another gum resin, used anciently by the Egyptian embalmers, and derived from the trees *Balsamodendron myrrha* and *Commiphora abyssinica* in Arabia and Africa. The name in Chinese was *mu yao*⁷ (R340; CC891), undoubtedly derived from the Persian, Hebrew or Latin forms of the appellation. On the botany and distribution see Burkill (1), vol. 1, pp. 961ff. According to Laufer (1), pp. 460ff., the oldest mention of the substance in China occurs in the *Nan Chou Chi*⁸ of Hsü Piao,⁹ a +4th-century book, not extant now but quoted by the *Hai Yao Pên Tshao*, as we see from CLPT, ch. 13, (p. 330.1). On the ancient trade in myrrh from Arabia Felix see van Beek (1).

^e The association of these with gold, and with the Three Magi, presents us naturally with powerful alchemical and symbolic undertones here. Cf. the story of the Cave of Adam in Vol. 5, pt. 4.

^f This was a solid purple gum produced by *Styrax officinalis*, a tree of the Levant (cf. Hanbury (1), pp. 129ff.; Burkill (1), vol. 2, p. 2107). We had occasion to refer to it at a much earlier stage, Vol. 1, p. 202. The Chinese name *su ho*¹⁰ has always been regarded as transliterating the *storax* of the ancient Mediterranean world, but neither Laufer (1), pp. 456ff. nor other philologists could explain the exact genesis of the sound; perhaps the intermediary language was Sogdian. PTKM, ch. 34, (p. 119), quotes the *Kuang Chih* as saying that Su-Ho was a country in the West. Storax was the first substance to which the term *su ho*¹⁰ was applied, but later the meaning changed as we shall see.

^g Gum guggul, from trees of the same genus as that which produces myrrh, *Balsamodendron mukul* and *B. Roxburghii* (Moldenke & Moldenke (1), p. 81). Bdellium or gum guggul was the first substance to which the term *an hsi hsiang*¹¹ was applied in China, but later its meaning changed to designate a Nan Hai product (see on). It is generally agreed that the Chinese words meant 'Parthian aromatic' (Laufer (1), pp. 464ff.), i.e. incense from one of the countries that Chang Chhien discovered (Vol. 1, p. 174). See further the detailed studies of Yamada Kentaro (2, 5).

^h Costus root is a term which applies to the fragrant roots of a number of plants, notably *Aucklandia Costus* and *Saussurea lappa* (= *Aplotaxis lappa*), widely distributed (cf. Burkill (1), vol. 2, p. 1968). In

¹ 白芷

² 芳香

³ 白芳香

⁴ 白茅香

⁵ 乳香

⁶ 返魂香

⁷ 沒藥

⁸ 南州記

⁹ 徐表

¹⁰ 蘇合

¹¹ 安息香

anise.^a The seventh, galbanum,^b allied to asafoetida, appeared in China only in the Tang and then not for very long. Here too might be added note of a couple of Mediterranean gums that never seem to have made their way to China, ladanum (cistus)^c and tragacanth.^d

If then in the earlier centuries of the era many components of incense were exported to China from the West, as time went on the resources of south-east Asia were more and more laid under contribution. The Sino-Mediterranean route was extremely long and often interrupted, while on the other hand growing political organisation of the Nan Hai, under rajahs, sultans and emirs, encouraged trade, and there were many advances on the Chinese side in shipmastery and navigation.^e Consequently we can list no less than fourteen aromatics which came up from the East Indies through the ports of the South China coast, either in the Han or soon after, by the Tang at least, in great quantities. Pre-eminent here were sandal-wood,^f aloes-wood (garroo),^g and laka-wood;^h cloves,ⁱ and that animal material of strange properties found floating on

Chinese there were various names, among which *kuang mu hsiang*^t may be taken as most typical (R 453). *Mu hsiang*² and *mi hsiang*³ may also have applied in China to the root-perfume of quite a different plant, *Inula racemosa* (Forbes & Hemsley (1), vol. 1, p. 430). In cases such as this, where several plants of wide distribution have been used, the origins and destinations at different times can only be worked out from literature in many languages (cf. Lin Thien-Wei (1), pp. 34ff.), and this has not yet been done. See Fig. 1341a.

^a See fn. h on p. 136 above.

^b A sweet gum resin from a small tree, *Ferula galbaniflua* (Schafer (13), p. 188; Laufer (1), p. 363). It was called *phi chhi*^{4,5} in Chinese, presumably a transliteration of Pers. *bīrsai*. But there are very few mentions of it, the chief perhaps being that in the *Yu-Yang Tsa Tzu* of Tuan Chhêng-Shih (+863), ch. 18, p. 11b.

^c A gum from *Cistus creticus* = *villosus*, mentioned as useful by Dioscorides (Gunther tr., 1, 128 on p. 68). Cf. Polunin & Huxley (1), p. 167.

^d A gummy exudate from *Astragalus gummifer*, a shrubby vetch of the Middle East (Sollmann (1), p. 746).

^e See Vol. 4, pt. 3, Sect. 29, esp. pp. 440ff., 554ff., 695ff.

^f This wood, with its marvellous perfume, is the yellowish heartwood of a small parasitic tree *Santalum album* growing in Java and other parts of Indonesia. Its Chinese name is *than hsiang*,⁶ *chan than*⁷ or *pai than*⁸ (R 590; CC 1572). The celebrated *than* wood of the classics, 'rosewood', was undoubtedly *Dalbergia hupeana* (R 381), from a quite different family. A third wood, of darker colour, 'purple rosewood', *tsu than*⁹ (R 404), or red sanderswood, much imported from the Nan Hai in and before the Tang, was *Pterocarpus Santalinus* (= *indicus*). On this whole subject see Schafer (8), as also (13), pp. 136ff. All these woods are of course still widely used today.

^g The wood, especially the diseased wood, of *Aquilaria agallocha*, growing in Annam, and called garroo after the Skr. *agaru* and Ar. *gharu*. But in Chinese it was always known as 'sinking aromatic', *chhen hsiang*¹⁰ (R 252; CC 648), because of its high specific gravity. At some later date a related species, *A. sinensis*, was found to be growing in Hainan. Cf. Yamada Kentaro (8). See Fig. 1339a.

^h The *kayu laka* of the Malays, dark wood from a climbing tree of the East Indies, *Dalbergia parviflora*; cf. Burkill (1), vol. 1, p. 754; Schafer (8). In Chinese it was known as 'purple liana aromatic', *tsu thêng hsiang*¹¹ (R 342). Since it gave a fragrance particularly appreciated by Taoists in their temple worship, it also acquired the name *chiang chen (jen) hsiang*¹² (the incense that summons the Perfected Ones to descend among us). The powdered wood is much used in joss-sticks at the present time.

ⁱ The dried flower-buds of *Caryophyllus aromaticus* (= *Eugenia caryophyllata* = *aromatica*), native to Indonesia, especially the Moluccas; cf. Burkill (1), vol. 1, pp. 961ff. As they looked like nails, or the tongues of chickens, the Chinese called them *ting hsiang*¹³ or *chi shê hsiang*¹⁴ correspondingly (R 244).

¹ 廣木香

² 木香

³ 蜜香

⁴ 潤齊

⁵ 融齊

⁶ 檀香

⁷ 旃檀

⁸ 白檀

⁹ 紫檀

¹⁰ 沉香

¹¹ 紫藤香

¹² 降真香

¹³ 丁香

¹⁴ 雞舌香

the ocean, ambergris.^a Two instructive cases show that the Chinese name of an earlier West Asian product was transferred to the later East Indian one. Thus earlier *an hsi hsiang*,¹ the Arsacid or Parthian aromatic just mentioned, was bdellium (gum guggul),^b but later *an hsi hsiang*^c was gum benzoin^c from Sumatra; while earlier *su ho hsiang*^d was solid storax^d from the West, but later *su ho hsiang*^e was Indonesian liquidambar,^e a liquid material—the trees being of quite a different genus in both cases. Of only slightly lesser importance were Baros camphor,^f *sēmbong* camphor,^g the true patchouli,^h and putchuk (costus), smelling of violets,ⁱ from its more ordinary sources. Originally the jasmynes^j and terebinth^k would presumably have had to be counted among these imported products of the spicy Indies, and these regions probably continued to produce the inferior form of frankincense^l which was used to adulterate the 'mammil-

^a Ambergris is a waxy pathological secretion (somewhat analogous to bezoar) formed in the intestines of the sperm whale *Physeter macrocephalus* = *catodon* as a response to the irritation caused by the beaks of the cephalopods (squids and octopuses) in its diet. In earlier times large lumps of ambergris used to be harvested from flotsam and jetsam cast up by the ocean, but the meagre present-day supplies come mostly from whaling stations (Bovill, 1). Ambergris, which itself has when pure a faintly aromatic smell, has always been greatly valued by perfumers because of its remarkable power of fixing for months delicate floral and other scents, and giving a special velvety quality to them. For this reason it was called in Chinese *tsu shao hua*¹ (R 103), though there was also a transliteration, *a mo hsiang*,² evidently derived from Ar. *al-'anbar*. The commonest name, however, was *lung hsien hsiang*³ (dragon spittle), but *tiao ching*⁴ (whale semen) was also current. For the history of the knowledge of ambergris in China see Schafer (13), p. 174, and especially Yamada Kentaro (1). On the chemistry of ambergris see Lederer (1).

^b See fn. g on p. 140 above.

^c This comes from *Styrax benzoin* and *S. tonkinense* which inhabit Siam and Sumatra (R 185; CC 473; Burkill (1), vol. 2, pp. 2105, 2108). Our curious word for it is a corruption of the Arabic term *lubān al-ḡawī*, the olibanum (see p. 140) of Java, hence 'gum benjamin' as well as benzoin (Burkill, *op. cit.* p. 2102). This etymological antiquarianism may perhaps be excused when we remember all that benzoic acid and the benzene ring have meant for the vast science of organic chemistry. See further the detailed studies of Yamada Kentaro (2, 5) on the travels of benzoin to Europe and to China.

^d See fn. f on p. 140 above.

^e This is the 'liquid storax' or 'rose malloes' (cf. Vol. 1, p. 203), derived from trees of the *Altingia* genus. *A. excelsa* (= *Liquidambar altingiana*) grows in Indonesia; it was for long the chief source, and the gummy exudate is obtained by tapping, as for rubber (Burkill (1), vol. 1, pp. 117ff.). But there is also *A. gracilipes* in Tongking, which certainly provided some of the later *su ho*⁷ used in China; and *L. formosana* (= *acerifolia*) was the origin of the *fēng hsiang chih*,⁸ another term for the same thing (R 463; CC 1182). There has been some confusion with *L. orientalis* (R 462; CC 1183), but that is a tree of Asia Minor (Burkill, *op. cit.* p. 116) and its gum was never exported to China. See Fig. 1339b.

^f Or Borneo camphor (laevo-borneol) from *Dryobalanops aromatica*, the classical *lung nao hsiang*⁹ of the Chinese (R 261; CC 697). But this 'dragon brain aromatic' was also called *pho lū kao*¹⁰ after Baros on the west coast of Sumatra, which was a great camphor entrepôt. For an alchemical experiment with it cf. pt. 3 below. There are special studies on its history by Yamada Kentaro (6, 7).

^g Or Malayan camphor (laevo-camphor) from *Blumea balsamifera* of the Compositae, *ai na hsiang*¹¹ (R 17; CC 2465; Burkill (1), vol. 1, p. 334), at first imported from the Nan Hai but afterwards produced also within China. Cf. Hanbury (7).

^h This fragrant oil (Tam. *pacilai*, Skr. *tamālapattra*), perhaps identical with the *malabathron* of the ancient West (cf. Vol. 1, p. 178), was derived from certain Malayan mints, *Pogostemon cablin* and *P. Heyneanum* (Schafer (13), p. 172; Burkill (1), vol. 2, pp. 1782ff.). Its Chinese name was *huo hsiang*.¹² Another species used was *P. purpureus*. But the same or a very similar perfume was also obtained from *Lophanthus rugosus* (= *Agastache rugosa*), indigenous to China (R 128; CC 318; Stuart (1), p. 247; Forbes & Hemsley (1), vol. 2, p. 288).

ⁱ See fn. h on p. 140 above.

^j See fn. a on p. 138 above.

^k See fn. i on p. 136 above.

^l See fn. c on p. 140 above.

¹ 安息香

² 蘇合香

³ 紫葳花

⁴ 阿末香

⁵ 龍涎香

⁶ 吊精

⁷ 蘇合

⁸ 楓香脂

⁹ 龍腦香

¹⁰ 婆律膏

¹¹ 艾納香

¹² 藿香

lary gum' exported from Western Asia. This completes the fourteen main substances assignable to the category of Nan Hai products.^a

How greatly appreciated they were can be seen, for example, by the list given in the *Hsin Hsiu Pên Tshao* (Newly Reorganised Pharmacopoeia) of +659, the oldest official pharmacopoeia in any civilisation. There we find^b the following six incense constituents as most prominent—aloes-wood or garroo (*chhen hsiang*¹), frankincense (*hsiun lu hsiang*²), cloves (*chi shê hsiang*³), patchouli (*huo hsiang*⁴), elemi (*mo thang hsiang*⁵) and liquidambar (*fêng hsiang*⁶). Of these the first could have been Hainanese but was more probably Annamese, the second Arabic and Indian, the third Moluccan, the fourth possibly Chinese but more likely Malayan, the fifth no doubt from South China but the sixth Indonesian, though possibly from Tongking or Formosa. Thus at least half were from the Chinese point of view exotic. 'These six kinds of perfume', says the text, 'are those considered most important in practice by the blenders of aromatics.'^c

Not surprising is it, therefore, to find very similar lists originating from the 'incense-guessing parties' (*kiki-kō*⁷) so much in vogue among the cultured aristocrats of the Heian period in Japan (+782 to +1167), especially the time when the famous *Genji Monogatari*⁸ (Tale of Genji)^d was written (the century from +967 to +1068). In the world of the Shining Prince, says Morris,^e the blending of incense was one of the great arts admired by the *cognoscenti*, and Murasaki Shikibu's⁹ fictional biography gives a graphic account of a competition of this kind organised by Genji.^f Commen-

^a Close study of these has enabled Wolters (1) to go far towards solving one of the toughest problems in the history of Chinese overseas trade, the nature of 'Malayan Persia' (Nan Hai (or Hsi Hai) Po-Ssu¹⁰). We said very little about this in foregoing volumes (save Vol. 3, pp. 653-4) because of the intractability of the question, but it is worth recalling here. Wolters was intrigued by the phrase Po-Ssu sung chih¹¹ (Po-Ssu pine resin) in four Chinese texts of the 4th century, and after examination of much evidence was able to show that most probably Sumatran resin from *Pinus Merkusii* went to China from then onwards as a cheap substitute for *Boswellia* frankincense. Pine resins fulfilled a parallel function in medieval Europe also. Similarly, *Commiphora* myrrh and *Balsamodendron* bdellium from Arabia were seconded (and even replaced) by Sumatran *Styrax* gum benzoin; while Chinese indigenous *Cinnamomum* camphor was supplemented by Sumatran and Malayan *Dryobalanops* camphor and *Blumea* camphor.

But who were the Po-Ssu people who muscled in on the Sino-Mediterranean trade in this way? Solutions of the 'Malayan Persia' puzzle have been many: an unidentified place or State somewhere in South-east Asia (Laufer, Sauvaget, Wang Kung-Wu), in Northern Sumatra (Ferrand), Pasai there (Phillips, Tsuboi Kumazo, Pelliot), Lambesi there (Gerini), colonies of Persian merchants there (Bretschneider, Moens), or Persian middlemen handling goods from east and west all over South-east Asia (Hirth & Rockhill). Wolters, however, believes that the only interpretation that meets the case is 'traders in Persian goods' (on the analogy of 'Genoese pastry' or 'images d'Epinal'), doubtless largely Sumatran Malays, no more Persian by race and culture than 'East Indiamen' were Indians. For only in Northern Sumatra—and this is what led Wolters to his conclusion—grow together all the three trees, *Pinus*, *Dryobalanops* and *Styrax*.

Paranavitana (4) adds the suggestion that the term Po-Ssu was derived from the Sanskrit name of an Indonesian people, *Vṛṣa* (pp. 19 ff.). Cf. Gunawardana (1), p. 40.

^b Ch. 12, pp. 12b, 13a.

^c *Tzhu liu chung hsiang chieh ho hsiang chia yao yung*.¹²

^d Genji Hikaru Kimi was not a real character, but one modelled on several real characters, among them being Sugawara no Michizane (cf. Vol. 4, pt. 3, p. 650).

^e (1), pp. 191 ff.

^f Ikeda ed., vol. 3, pp. 320-2. Tr. Waley (27), vol. 4, pp. 90 ff.

¹ 沉香

² 熏陸香

³ 雞舌香

⁴ 藿香

⁵ 磨磻香

⁶ 楓香

⁷ 聞香

⁸ 源氏物語

⁹ 紫式部

¹⁰ 南海(西海)波斯

¹¹ 波斯松脂

¹² 此六種香皆合香家要用

tators have identified nine components in the four types of mixture used on this occasion, from which it can be seen that on the whole there is much similarity with the *Hsin Hsiu Pên Tshao* list, aloes, frankincense (Indian), clove and liquidambar being common to both. The Japanese list omits patchouli and elemi, but adds onycha, sandal, musk, pine-resin and 'tropical tulip' (perhaps saffron).^a It is interesting that five of its components (cassia, onycha, musk, pine-resin and liquidambar) were Chinese or indigenous in origin, while four others were Indo-Chinese or East Indian, and one, the saffron (if this identification is right), was from Western Asia. Cassia and onycha occur in all four types of blend, aloes, frankincense and musk in three, the others only in two or one. This whole pastime, elegant in the extreme, originated no doubt among the Chinese Taoists and literati in Thang or pre-Thang times, and still continues in East Asia to the present day.^b

But there are still some components to be mentioned which the incense-makers introduced into their powders, pastes and solid blends;^c to understand these we must recur to the manner in which the materials were used. One could burn, as we saw, whole logs of perfumed wood, or one could cast the mixed gums (as is done daily in the liturgies of Christendom) on to glowing charcoal; or one could make a hardening or setting paste, or else a tindery powder which could be poured out in long meandering trails like slow-match to give a peripatetic glow that lasts for a long time—and can be made to tell it. The two latter methods are particularly characteristic of East Asia. Into the setting paste it was (and still is) customary to dip very thin sticks of wood on the principle of the candle-wick;^d but from medieval times onwards an alternative method was used, that of extrusion from a kind of syringe or pump through small holes in a draw-plate, as for some kinds of noodles in food technology.^e The resulting stick may be straight, as in the domestic incense still to this day exported from Peking, or formed into the small or large coils already mentioned (Fig. 1316). A modern eye-witness description of the process has been given by Gontran de Poncins,^f but even more valuable is the evidence of Gabriel de Magalhaens (+1611 to +1677) that the technique was already fully developed in his time.^g The setting paste was also (and

^a On saffron, safflower and turmeric see the learned disquisition of Laufer (1), pp. 309ff. The flowers of *Crocus sativus*, imported from West Asia, served as a delicate aromatic as well as a colouring-matter; the Chinese name was *yü chin*.¹ We shall consider these plants more fully in Sect. 38 (Vol. 6, pt. 1). Saffron was also called *fan hung hua*,² and transliterated *tsa fu lan*³ and *sa fa chi*⁴ (R654; CC1776). *Chi* here was a corruption from *lang*.⁵ See Fig. 1340a.

^b The comments on it of Chamberlain (1), p. 219, are worthy to stand among the unloveliest examples of European prejudice and stupidity.

^c Cf. Li Chhiao-Phing (1), p. 146; de Poncins (1); Bedini (5).

^d Often itself a stick or reed, though a stouter one, in China. On the techniques of candle-making see Hommel (1), pp. 34, 36, 166, 318ff.

^e Ancestral techniques, these, with wire-drawing, of the modern 'spinning' of artificial textile fibres. And the principle has been extended to the furthest bounds of basic biological science, since artificial muscle fibrils have been formed by the extrusion of sols of the elongated molecules of the muscle proteins.

^f (1), cit. in Bedini (5), p. 44.

^g (1), pp. 153-4, a passage given by us already in Vol. 3, p. 330. Cit. also in Bedini (5), p. 23, a modernised translation.

¹ 鬱金

² 番紅花

³ 咱夫藍

⁴ 撒法即

⁵ 郎

still is) formed into small cones, of which one lights the tip; and it is with cones of this kind, burnt down to the skin of his shaven head, that the Buddhist monk receives the indelible stigma of his ordination (Fig. 1320).^a Preliminary grinding of the many wood-dusts and dried gum powders is done either with pestles and stone mortars or with the foot-worked longitudinal-travel edge-runner mill (*yen nien*¹) described in an earlier volume.^b Among the various vehicles or 'diluent' needed for the tindery effect and the setting are elm-root,^c the wood sawdusts of cypress,^d juniper,^e myrtle,^f and cedar,^g the dried leaves of *Perilla*,^h the refuse of the nutmeg,ⁱ pine resin^j and 'gum arabic'^k of various kinds.^l Thinning to the right degree is accomplished with water and alcohol (distilled wine). Traces of rhubarb and saltpetre may have been sometimes added.

^a There is a close connection here with the medical technique of moxibustion, discussed in detail in Sect. 44.

^b Vol. 4, pt. 2, pp. 195, 197.

^c From *Ulmus campestris*, *yü*² (R606) and other species. Only the bark of the root is used. See de Poncins (1).

^d Presumably *Cryptomeria* (= *Cupressus*) *japonica*, the *shan*³ or *liu shan*⁴ (R786a; CC2137).

^e *Juniperus chinensis*, *kuei*⁵ (R787; CC2143; Burkill (1), vol. 2, p. 1272).

^f In China probably *Myrica rubra*, *yang mei*⁶ (R621; CC1687).

^g In China this would be *Cedrela* (= *Toona*) *sinensis* (= *odorata*), the *chhun*⁷ (R334; CC885).

^h *Perilla ocimoides* (= *frutescens*), *jen*,⁸ a plant related to the sweet basil (R135a; CC343; Burkill (1), vol. 2, p. 1694). The seeds give a drying oil, and the presence of citral in other parts led to use as food flavouring like mint. Emphasis on the dried leaf powder as a constituent favouring the slow even burning of time-keeping incense occurs in the account of Shen Li in +1074 (cf. p. 134 above, and Bedini (5), p. 11). He also recommended for the same purpose the withered and dried flowers of the pine-tree, carefully powdered.

ⁱ *Myristica fragrans* (= *officinalis*), *jou tou khou*,⁹ the brown nut (R503; CC1336; Burkill (1), vol. 2, pp. 1522ff.). The coral-red aril or inner coat of the nutmeg, which partakes of the aroma, comes into commerce as mace (*jou tou hua*¹⁰).

^j *Sung hsiang*,¹¹ *sung chih*,¹² *sung kao*,¹³ *sung fang*,¹⁴ *sung chia*¹⁵—there were many names for it. The chief source was presumably the red pine, *Pinus Massoniana* (R789a1; CC2131; Stuart (1), p. 333).

^k Europe has obtained 'gum arabic' for its adhesive preparations from the Sudan, then West Africa, then India, for a couple of millennia, and always from the *Acacia* genus of the Leguminosae. The gum exudes as a pathological phenomenon, and its flow is stimulated by injury. *A. senegal* was always one of the best species, but *A. arabica* was also used, and in India *A. catechu* (cf. Burkill (1), vol. 1, pp. 13ff., 20). Under various names, cutch, gambier, catechu, etc., the product of this last species, useful in tanning and dyeing as well as in pharmacy, went in commerce both westwards and north-eastwards from early times. Its Chinese names were also diverse, e.g. *a hsien yao*,¹⁶ *erh chha*,¹⁷ *wu tieh ni*,¹⁸ and *hai erh ni*¹⁹ (CC947; Stuart (1), p. 2). But there was also an indigenous 'gum arabic' tree, *Acacia farnesiana*, widespread in South China and very like *A. arabica*, called *ching chhiu hua*²⁰ and *chin ho huan*²¹ (CC949); this would have been what the incense-makers mostly used.

^l Among fumigatory substances 'mosquito incense' (*wên tzu hsiang*²²), an insecticide very familiar to all those who have lived in China, must not be forgotten. It usually contains, besides a selection of the more ordinary ingredients, wormwood moxa (*ai*²³), *Artemisia vulgaris*, var. *indica* (R9; CC17; Burkill (1), vol. 1, p. 245) which contributes cineol and other volatile essential oils. It is also likely to include the powdered leaf of the tobacco-plant (*yen tshao*²⁴), *Nicotiana Tabacum* (CC303); with a little arsenic and sulphur. Besides, in different parts of the country special additions of local plant substances may be made, for there are many good insecticides in China which have been known and used for centuries—for example the *Illicium* already mentioned (see fn. h on p. 136), as also the thundergod vine, and various forms of pyrethrum, which we shall encounter in Sects. 38 and 42 (Vol. 6).

¹ 研礪

² 楸

³ 杉

⁴ 柳杉

⁵ 檜

⁶ 楊梅

⁷ 椿

⁸ 荏

⁹ 肉豆蔻

¹⁰ 肉豆蔻

¹¹ 松香

¹² 松脂

¹³ 松膏

¹⁴ 松肪

¹⁵ 松膠

¹⁶ 阿仙藥

¹⁷ 兒茶

¹⁸ 烏爹泥

¹⁹ 孩兒泥

²⁰ 荊球花

²¹ 金合歡

²² 蚊子香

²³ 艾

²⁴ 煙草

During the centuries a wealth of techniques for dealing with the innumerable aromatics grew up, and we may have opportunity to look more closely at some of them in the Sections on botany and agricultural arts in Vol. 6. The subject is also necessarily involved with the history of distillation (cf. Vol. 5, pt. 4 below). Here however one excerpt conveniently at hand may be adduced as an example of the subtlety involved. It comes from the *Ling Wai Tai Ta*¹ (Information on What is Beyond the Passes), Chou Chhü-Fei's² great work on exotica of +1178. He says:³

The 'bubble flower' (*phao hua*³) is sometimes called by southerners the flower of the pommelo tree (*yu hua*⁴).^b When its buds open in the spring they are round and white like huge pearls; after picking, the fragrance is rather like camellias, marvellously pure and good, quite able to challenge the sweetness of jasmine. The Cantonese of Phan-yü district take them and steam (or distil) them (*chéng*⁵) to prepare the perfume, obtaining excellent results. Also certain people in Kueilin (in Kuangsi) who like to busy themselves about such things practise a method of perfume-making as follows. They cut ligna-oes (*chhen hsiang*⁶)^c of good quality into thin slices and place them at the bottom of a vessel that has been well cleaned. The half-open citrous blossoms are scattered over these, then covered by another layer of aloes shavings, then another layer of pommelo flowers is made, and so on alternately. When full the vessel is tightly closed. Next day, fresh flowers are put in to displace those in the old layers, without waiting for them to wither; and the changes are continued until the flowering season is quite over and the perfume perfected. In the Wu family at Phan-yü, *hsin tzu hsiang*⁷ and *chhiung hsiang*⁸ are made in the same way using *su hsiang*⁹ (jasmine) and *mo li*¹⁰ (sambac jasmine) respectively. The general principle is that one must press the moisture out of the flowers in order to collect their *chhi* (perfume) and let it spontaneously permeate the fragrant wood. Thus (in this method) they never use steamer vessels to heat and distil it (*shih wei chhang i tséng fu chéng chu chih*¹¹).

This must be one of the earliest statements of what is called 'enfleurage', a method for effecting the diffusion of a volatile essential oil from a flower into a fatty substance.^d Distilling to separate the oils sometimes followed, at least in later periods (cf. pt. 4).

Lastly a word must here be said about the role of incense in horology, hinted at several times in the foregoing, and briefly referred to from time to time in previous volumes.^e The 'joss-stick' (*hsiang pang*¹²) in one form or another was assuredly the medieval Chinese navigator's equivalent of the 'mariner's dyoll' or sand-glass of the West. It probably was a calibrated stick or sticks wherewith they kept their watches at night or under cloud or storm, but it may have been something more complex than this, for at least from the Sung onwards veritable metal incense-clocks (*hsiang chuan*¹³) were made in which the burning-point of a trail of powder was made to wind its way

^a Ch. 8, p. 14a, tr. auct.

^b *Citrus decumana* (R 344).

^c See fn. g on p. 141 above concerning *Aquilaria agallocha*, from Annam or Hainan.

^d Cf. Hanbury (8).

^e See Vol. 3, p. 330, Vol. 4, pt. 2, p. 509, Vol. 4, pt. 3, p. 570. The use of incense in some form or other for time-telling is attested in the poems of Yü Chien-Wu¹⁴ already (fl. +520).

¹ 嶺外代客

² 周去非

³ 泡花

⁴ 柚花

⁵ 蒸

⁶ 沉香

⁷ 心字香

⁸ 瓊香

⁹ 素馨

¹⁰ 茉莉

¹¹ 實未嘗以甌釜蒸煮之

¹² 香棒

¹³ 香篆

¹⁴ 庾吾肩

through the strokes of a stylised seal character (hence the name), or a geometrical maze.^a By substituting patterns with varying total runs it was easily possible to arrange for the measurement of the unequal night-watches (*kêng*¹), which varied with the seasons, as well as for that of the twelve double-hours (*shih*²) and the hundred quarters (*kho*³) standard throughout the year and needing no change of plate. In one of these discoidal forms the glow trail was arranged so as to be Yin (narrowing and centripetal) during one double-hour, and Yang (expanding and centrifugal) during the next. According to the evidence in Shen Li's book already mentioned this pattern was invented by a candidate-official Mei Chhi^b in +1073 and made by a gifted artisan Wu Chêng-Chung⁵ in the following years. But the general principle may have been much older, for Yabuuchi Kiyoshi has cited^c a *Lou Kho Ching*⁶ (Clepsydra Manual) which mentioned a 'smoke seal clock' (*yen chuan*⁷). All works of this title are lost, but all were ancient, the oldest perhaps by Ho Jung⁸ (c. +102), then one by Chu Shih⁹ in the Chhen dynasty (+563), and another by an Astronomer-Royal, Sung Ching,¹⁰ a little later, finally a definitive treatise by Huangfu Hung-Tsé¹¹ in the Sui or early Thang. Unfortunately it is not clear from which of these the fragment in question came, but in any case it seems very probable that the system first started in the pre-Thang centuries rather than towards the end of the Northern Sung. Besides, there are references to *hsiang yin*¹² (incense seals) in Thang poetry.^d Many incense-seal clocks in all kinds of fanciful shapes and patterns still exist today,^e though few perhaps are used. Even an alarm device was embodied in one form, where a straight stick of incense was supported in the trough of an elaborately carved container shaped like a dragon-boat; when the glow of combustion reached a certain point a fine thread was ignited letting drop a pair of little weights into a metal dish below.^f Some of these incense-clocks embodied graduated scales. Graduated candles (*kho chu*¹³) were also known and used in China from the Liu Chhao period (+4th or +5th century) onwards, for they are mentioned several times in the *Nan Shih*.^g Finally the timing of alchemical and iatrochemical operations was often measured in terms of incense-sticks and combustion clocks of one kind or another, as many texts indicate pretty clearly (cf. pts. 3, 4 and 5 below).

^a For further details the reader is referred to the admirable publications of Bedini (5, 6) on this subject.

^b This may be a *ming-tzu* or a pseudonym rather than a surname and a given name.

^c (4), p. 23, without reference.

^d As, for example, in some of the verses of Fang Kan¹⁴ (fl. +860).

^e Cf. Vol. 3, Fig. 145. Abundant information and illustrations will be found in Bedini, *op. cit.*, with many quotations from late Western writers and travellers as well as translations of the most important Sung texts.

^f Cf. the striking mechanisms described in Vol. 1, p. 203. Auditory signals of this kind were used both in Arabic anaphoric water-clocks and Chinese hydro-mechanical clockwork. That the type of alarm here noted goes back at least to the +11th century could be deduced from Wang Fu's name for his dropping balls device—the 'candle dragon'; see Vol. 4, pt. 2, p. 499. At that time we could not explain this name.

^g Cf. Morohashi *enc.*, vol. 2, p. 264. And by the poet Yü Chien-Wu already mentioned.

¹ 更

² 時

³ 刻

⁴ 梅溪

⁵ 吳正仲

⁶ 漏刻經

⁷ 煙篆

⁸ 霍融

⁹ 朱史

¹⁰ 宋景

¹¹ 皇甫洪澤

¹² 香印

¹³ 刻燭

¹⁴ 方干

(ii) *Fumigation, expellant and inductant*

We must now return to the wilder shores of religion and liturgy by way of the 'smoking out' of undesirable things in general. As already adumbrated, the burning of incense was only part of a much wider complex in Chinese custom, fumigation as such (*hsün*^{1,2}).^a That this type of procedure, carried on for hygienic and insecticidal reasons, was much older than the Han appears at once from a *locus classicus* in the *Shih Ching* (Book of Odes), where the annual purification of dwellings is referred to in an ancient song. It says:

In the tenth month, the crickets
Chirp, chirp beneath our beds.
Chinks are filled up, and rats are smoked out,
Windows that face the north are stopped up
And all the doors are plastered...
The Changing of the Year requires it...^b

This could be dated in the -7th century or somewhat earlier. It is perhaps the oldest mention of the universal later custom of 'changing the fire' (*kuan huo*,³ *huan huo*⁴), a 'new fire' ceremony annually carried out in every home.^c The medical fumigation of houses, after sealing all the apertures, with *Catalpa* wood, is referred to in the *Kuan Tzu* book not many centuries later,^d and the *Chou Li*, of archaising tendency even if a Chhien Han compilation, has several descriptions of officials superintending fumigation with the insecticidal principles of the plants *Illicium* and *Pyrethrum*.^e From later literature we know that Chinese scholars regularly fumigated their libraries to keep down the depredations of bookworms, a great pest, especially in the centre and south.^f

^a The plant denoted by this character (with the appropriate radical), *hsün*,⁵ with which *hui tshao*⁶ has been synonymous at least since the +5th century, has always been difficult to determine, but it was probably the sweet basil, *Ocimum basilicum* (cf. fn. d on p. 136 above), a fragrant labiate (R134a). Owing to a mis-identification in this entry of Read, Hawkes (1), p. 23, translating the *Li Sao* (*Chhu Tzhu Pu Chu*, ch. 1, p. 8b), made it melilot, but this should probably not be retained. See also B 11 85, 406, 407, 11160; and Chu Chi-Hai (1), pp. 90ff.

^b Mao no. 154; tr. Legge (8), vol. 1, p. 230; Karlgren (14), p. 98; Waley (1), p. 166.

^c Cf. Bodde (12), p. 75; Fan Hsing-Chun (1), pp. 24-5. This kind of ceremony occurs in many civilisations at particular times of the year. In Christendom the Western Church adopted it for the beginning of the liturgy of Easter Eve, where in splendid symbolism it is still used. The point is not to go on propagating vegetatively from embers but to create sexually anew from flint and stone or other means.

^d Ch. 53, p. 111b; cf. Needham & Lu Gwei-Djen (1), p. 449.

^e Ch. 9, pp. 5b, 6b, ch. 10, pp. 7a, 9a; tr. Biot (1), vol. 2, pp. 386ff., discussed by Needham & Lu (1), pp. 436-7. Cf. Shih Shu-Chhing (2).

^f A number of plants were used to make the smoke, notably *yün hsiang*,⁷ i.e. rue, from *Ruta graveolens*, allied to the citrous family (B 11409; CC919; Burkill (1), vol. 2, p. 1921). This material, with other vegetable insecticides, was also sometimes incorporated in the paper and bindings of the books themselves. Another useful plant for these purposes was a tree related to the walnut, giving *pi li hsiang*,⁸ *Platycarya strobilacea* (= *Fortunea chinensis*); R620a; CC1683.

There is no single 'bookworm' species, but the most serious damage is caused by beetle larvae of the family Anobiidae, especially the cosmopolitan bread beetle *Stegobium* (= *Sitodrepa*) *paniceum* (Khung et al. (1), p. 412), and the library beetle *Nicobium castaneum*, more northerly in habitat. The drugstore

¹ 熏

² 燻

³ 燭火

⁴ 換火

⁵ 薰

⁶ 薰草

⁷ 芸香

⁸ 必栗香

Not only in peace, moreover, but also in war, the ancient Chinese were great smoke-producers. We have already encountered the toxic smokes and smoke-screens generated by pumps and furnaces for siege warfare in the military sections of the *Mo Tzu* book (-4th century), especially as part of the techniques of sapping and mining;^a for this purpose mustard and other dried vegetable material containing irritant volatile oils was used. There may not be sources much earlier than this, but there are certainly abundant sources later, for all through the centuries these strangely modern, if reprehensible, techniques were elaborated *ad infinitum*. For example, another device of the same kind, the toxic smoke-bombs (*huo chhiu*)¹ of the +15th century, came up for discussion in the same volume,^b and this recalled the numerous detailed formulae given in the *Wu Ching Tsung Yao* of +1044, so often quoted.^c The sea-battles of the +12th century between the Sung and the Chin Tartars, as well as the civil wars and rebellions of the time, show many further examples of the use of toxic smokes containing lime and arsenic.^d Indeed, the earth-shaking invention of gunpowder itself, some time probably in the +9th century, was closely related to these, for it certainly derived, as they did, from incendiary preparations, and its earliest formulae sometimes contained arsenic.^e Such techniques being so old, it is not perhaps surprising to find that the uses of scalding steam in medical sterilisation were appreciated as early as the +10th century. Thus in his *Ko Wu Tshu Than*² (Simple Discourses on the Investigation of Things) about +980 Tsan-Ning³ wrote:^f 'When there is an epidemic of febrile disease, let the clothes of the sick persons be collected as soon as possible after the onset of the malady and thoroughly steamed; in this way the rest of the family will escape infection.' This would have intrigued Pasteur and Lister; naturally we shall return to the subject in Sect. 44 on medicine and hygiene. The evil and the beneficent effects of natural knowledge have always gone hand in hand. Such is man's nature.

The demonifuge aspect of holy smokes is shown to perfection in one of the recipes in the *Tan Ching Yao Chieh* (Essentials of the Elixir Manuals for Oral Transmission) written by Sun Ssu-Mo about +640 (cf. pt. 3 below). Called 'Formula for mixing demon-killing pellets for use during the preparation of elixirs' (*Lien tan ho sha kuei wan fa*), it contains no less than twenty ingredients nearly all of poisonous character.^g Cinnabar, sulphur and the two arsenical sulphides form the inorganic base, but to them are added seven plant roots containing more or less powerful pharmacological beetle *Lasioderma serricorne* also sometimes does great damage, and coleoptera of quite other families such as Ptinidae and Dermestidae have been known to injure books from time to time. The silverfish, *Lepisma saccharina* (*i yü*), noted in Chinese texts as killed by fumigation, may occasionally do so, but it is not the main danger. It is curious that neither Li Shih-Chen nor the older pharmaceutical naturalists seem to have paid much attention to these pests. For further information see Weiss & Carruthers (1); Lepesme (1); Essig (1) and A. W. McKenny Hughes (1).

^a See Vol. 4, pt. 2, pp. 137-8.

^b Vol. 4, pt. 2, p. 425. Cf. Vol. 4, pt. 3, p. 684.

^c E.g. *WCTY/CC*, ch. 12, p. 67b. See Davis & Ware (1); Wang Ling (1); and Needham (47).

^d See Vol. 4, pt. 2, pp. 420-1, Vol. 4, pt. 3, p. 692.

^e We discuss all this fully in Sect. 30 (k).

^f Ch. 2, (p. 32), tr. auct.

^g *YCCC*, ch. 71, p. 19a; tr. & comm. Sivin (1), pp. 208-9.

¹ 火毬

² 格物圖說

³ 贊寧

⁴ 鍊丹合殺鬼丸法

⁵ 衣魚

active principles,^a five similar fruits, seeds or stems,^b and four animal products.^c This preparation was to be burnt like incense, and Sun Ssu-Mo guaranteed that it would kill every kind of gremlin impeding the work of the alchemist. It would probably kill anything else as well, hence the belief; and for human beings its smoke would have been intensely irritating, apart from other alarming physiological symptoms. Sun says that Ko Hung always used to employ this formula to purify his laboratory from devils before subliming the 'Triply wondrous elixir' (*San chhi tan*).^d

What concerns us here even more however is the possibility that the ancient Taoists generated hallucinogenic smokes in their incense-burners. It has been suggested that the incense of Taoist liturgy was at least as much a technique of fumigation and purification as a sweet-smelling offering to the gods, or at least that it began shamanistically in that way.^e Emphasis on the symbolic and anaphoric aspect grew perhaps after Buddhism came in, and certainly there were many indigenous ancient customs, as we have just seen, which would have led naturally to the former. If one wanted to drive away demons (as well as rats and insects) by 'making a stink', the addition of sulphur, mustard, horn keratin and suchlike substances to the 'incense'-burner would have been an obvious thing, showing once again the unsuspected relation between this furnace and that of the alchemist; and it might not have been long before the Taoists found they could use this as a psychological alchemy powerful indeed.^f The addition of hemp (*ta ma*,² *huo ma*,³ *Cannabis sativa* = *indica*) to the contents of incense-burners is clearly stated in one Taoist collection, the *Wu Shang Pi Yao*⁴ (Essentials of the Matchless Books),^g which must place it before +570. That the psycho-pharmacological properties of the plant (commonly called hashish, marijuana, etc.) were known in the Han or before is clear from the statement in the *Shen Nung Pên Tshao Ching*^h under *ma fên*⁵ (hemp seeds):

To take much makes people see demons and throw themselves about like maniacs (*to shih ling jen chien kuei, khuang tsou*). But if one takes it over a long period of time one can communicate with the spirits,ⁱ and one's body becomes light^j (*chui fu thung shen ming, chhing shen*).

^a *Veratrum niger* (R225), *Aconitum* sp. (R523), tubers collected both in spring and autumn, *Pinellia tuberifera* (R911), *Hosta* sp. (R520), *Atractylis ovata* (R14), closely connected with the immortality cult since ancient times, cf. pt. 3; finally *Gelsemium elegans* (R174) or *Rhus toxicodendron* (R317).

^b *Illicium religiosum* (R505), a notable fish and insect poison, cf. Needham & Lu Gwei-Djen (1), *Solanum dulcamara* (probably), *Prunus persica*, *Croton tiglium* (R322) and *Euonymus alatus* (R308).

^c Rhinoceros horn, musk, dried centipedes (*Scolopendra morsitans*) and cow bezoar. This last (intestinal and biliary calculi) came mostly from goats; the material contains only lime, bilirubin and cholic acids.

^d Not otherwise known.

^e Schipper (3). One remembers the acrid steam of vinegar still used in certain liturgical practices, and the penitential self-flagellation and violent prostration of the early Taoist Church, on which Yang Lien-Shêng (2) has written. Any quasi-orgiastic rite would be assisted by strong olfactory stimuli, to say nothing of psychotropic drugs in aerosol form.

^f So what started as a 'smoking out' of undesirable things, changed now to a 'smoking in' of heavenly things into oneself.

^g TT1124. See Schipper (3).

^h Mori ed., ch. 1, (p. 51), tr. auct.

ⁱ Or, 'gain insight'.

^j A characteristic prelude to material immortality.

¹ 三奇丹

² 大麻

³ 火麻

⁴ 無上秘要

⁵ 麻實

⁶ 多食令人見鬼狂走

⁷ 久服通神明輕身

The same entry gives also the synonym *ma pho*,¹ a technical term which may have embodied within itself a warning of the effects of hemp, for *pho*² often means an unpredictable and sudden change of mood, as happens in those under the influence of psychotropic drugs.^a Later on, *ma hua*,³ 'hemp flowers', became yet another synonym.^b All this is understandable because the traditional hashish of the Middle East and India used by smokers^c is the dried inflorescences of the female plant, containing undeveloped seeds and rich in the pharmacodynamic resins.^d

The text just quoted belongs to the -2nd or -1st century rather than the Later Han, and the knowledge was probably current among the Naturalists in the late Warring States period, for the word *fên*,⁴ applying only to hemp-seeds, is in the -3rd-century *Erh Ya*. One suspects that its origin lay in the conviction of the proto-Taoists of the Chou period that for the attainment of longevity and immortality one should abstain from cereals (*chüeh ku*⁵) and live upon all kinds of unlikely plants and vegetables (cf. Vol. 5, pt. 3). Sometimes these turned out to have rather extraordinary

^a There is a classical phrase in late Chou writings: *sê pho ju yeh*,⁶ 'at this he changed countenance'. And *pho jan ta nu*,⁷ 'suddenly he became very angry', is a usual expression. At the same time the word *pho* has also been explained botanically as sudden blooming or dehiscence (cf. Li Chhang-Nien (2), p. 37).

^b As in *Chhien Chün I Fang* (+670), ch. 4, (p. 52.2).

^c See Burkill (1), vol. 1, p. 438; Dey (1). There is a technical terminology here, for all hashish is not exactly the same thing. *Chur* consists of resin-rich fragments that break off, and *charas* is the resin separated and purified. The desiccated ripe inflorescences with most of the resin gone are called *ganja*, and these are eaten as well as smoked; while the leaves of both female and male plants, *bhang* (or, if powdered, *siddhi*), the least effective, are also smoked as well as eaten. An important characteristic of hemp is the very high Minimal Lethal Dose of its active principles, and overdoses do not kill, though prolonged use is thought to lead to insanity. For recent work on the chemistry of hashish the reviews of Mechoulam & Gaoni (1) and Joyce & Curry (1) may be consulted. There are alkaloids like cannabine, oils like cannabinal and resins like cannabinone. The chief pharmacologically active compound seems to be δ -9-tetrahydrocannabinol, with three rings, and 1 mg is a potent dose for man. Hashish smoking was never prominent in Chinese culture, as it has been in India, the Middle East and Africa, and on the whole the medical uses of the plant in China have been in external application rather than ingestion (*PTKM*, ch. 22, (pp. 49ff.); Stuart (1), p. 90; Anon. (57), vol. 2, pp. 66-7).

But the white seeds with the pericarp removed (*ma jen*⁸) were eaten as a 'tonic cereal', and when subjected to pressing made a valuable industrial drying oil (*ma yu*⁹) used for waterproofing paper and cloth.

It is interesting that the only other genus in the *Cannabis* family is *Humulus*, and the hop provides the classical example of an active principle which man has used to keep his alcoholic fermentations on the right track.

^d Grinspoon (1) has an interesting account of the chemistry of the active substances, but what he has to say on the Chinese history of the drug-plant needs much qualifying. Li Shih-Chen (*PTKM*, ch. 22, p. 50) quotes 'Thao Hung-Ching as follows: 'Hemp-seeds are very little used in medicine, but the magician-technicians (*shu chia*¹⁰) say that if one consumes them with ginseng it will give one preternatural knowledge of events in the future.' Characteristically, Li Shih-Chen comments that this preparation may well cure forgetfulness or absent-mindedness, but to believe that it will reveal coming affairs would really be going too far.

The use of hemp as an anaesthetic has often been attributed to Hua Tho,¹¹ the great +3rd-century physician and surgeon, as by St. Julien (11) and Tatarinov (2), but there are good pharmacological reasons why it would have been unsuitable for this purpose, and we suspect a confusion between the plant, *ma*,¹² and *ma*,¹³ 'to numb'. We discuss the matter fully in Vol. 6, Sect. 45.

¹ 麻勃

² 勃

³ 麻花

⁴ 寶

⁵ 絕穀

⁶ 色勃如也

⁷ 勃然大怒

⁸ 麻仁

⁹ 麻油

¹⁰ 術家

¹¹ 華佗

¹² 麻

¹³ 癱

properties. The *Pên Ching* statement was copied time after time in later books.^a For these 'psychedelic' experiences in ancient Taoism a closed room would have been necessary, and precisely the 'Pure Chamber' of the oldest Taoist rites was available;^b indeed a text of the +4th century suggests just this:

For those who begin practising the Tao it is not necessary to go into the mountains... Some with purifying incense and sprinkling and sweeping are also able to call down the Perfected Immortals. The followers of the Lady Wei (Hua-Tshun) and of Hsü (Mi) are of this kind.

This comes from the *Yuan-Shih Shang Chen Chung Hsien Chi*¹ (Record of the Assemblies of the Perfected Immortals; a Yuan-Shih Scripture).^c The two leaders mentioned were great figures in the Mao Shan school of Taoism (Mao Shan Phai²); the matriarch Wei Hua-Tshun³ was active between +350 and +380,^d while Hsü Mi,⁴ whom we have come across before (p. 110), died in +373. Something might also be gained by pursuing mythological connections with the Hemp Damsel,^e Ma Ku,⁵ goddess of the slopes of Thai Shan,⁶ where the plant was supposed to be gathered on the seventh day of the seventh month, a day of seance banquets in the Taoist communities.^f

^a For example, Sun Ssu-Mo,⁷ in his *Chhien Chin I Fang*, ch. 4, (p. 52.2), c. +670. Just about the same time Mêng Shen,⁸ in his *Shih Liao Pên Tshao*⁹ (Nutritional Natural History), quoted it from a Taoist *Tung Shen Ching*,¹⁰ presumably either the *Tung Shen Pa Ti Miao Ching Ching*¹¹ (TT635) or more probably the *Tung Shen Pa Ti Yuan Pien Ching*¹² (TT1187). This text gives instructions for taking the hemp, and says that those who wish to see demons should take it (with certain other drugs) for up to a hundred days. What Mêng Shen said was quoted later on in the *Thu Ching Yen I Pên Tshao* (TT761) of +1223 (ch. 37, p. 9a). Thus the hallucinogenic properties of hemp were common knowledge in Chinese medical and Taoist circles for two millennia or more. It occurs in various +4th-century prescriptions for gaining visionary power (e.g. *Chen Kao*, ch. 10, pp. 4b, 5a). Yang Hsi¹³ describes (*Chen Kao*, ch. 17, pp. 14b, 15a) his own experiences on using the Chhu Shen Wan¹⁴ (Pill of Commencing Immortals) which contains much hemp. The formula of this medicine, directed against the Three Worms (San Chhung¹⁵), is given in the *Tzu-Yang Chen Jen Nei Chuan*¹⁶ (Biography of the Adept of the Purple Yang, i.e. Chou I-Shan¹⁷), TT300, written before, but perhaps not long before, +399 (tr. Maspero (13), pp. 103-4).

^b It is remarkable that the injunction 'don't look round!' (*wu fan ku*¹⁸) is frequent in the directions for doing obeisance to the incense-burner in the Pure Chamber oratory. This might suggest the need for concentration on the hallucinogenic smoke. Our attention to this was kindly drawn by Mr Michel Strickmann, who also provided the references in the latter part of the preceding footnote.

^c TT163, p. 9b, found by Schipper (3).

^d Or rather earlier, for the *Shang Chhing Ching*,¹⁹ a book of thirty-six revelations about the Taoist pantheon, was supposed to have been dictated to Yang Hsi by her, and its oldest parts belong to the neighbourhood of +316. She it was who explained to Yang Hsi how to conduct meditation in the 'Pure Chamber'.

^e Supposedly a virgin of the +2nd century who not only achieved immortality with her brother Wang Yuan²⁰ and his friend Tshai Ching²¹ but was deified into the bargain (cf. *Shen Hsien Chuan*, ch. 2, p. 5a, b). She has been of particular interest to us because of her close connection with the geological doctrine of the 'mulberry groves' (*sang thien*²²), namely that high mountains were once at the bottom of the sea (and will be again), and vice versa; cf. Vol. 3, p. 600. Cf. Fig. 1321.

^f We have said nothing here of any foreign influences, which would take us too far afield, but one cannot help remembering the well-known account of the Scythians by Herodotus (IV, 75). He says nothing directly of hallucinations, but he does say that the Scythians, who never washed in the ordinary manner, exposed themselves within felt wigwags to the steam and smoke of hemp-seeds roasting on

¹ 元始上真象仙記

² 麻姑

³ 洞神經

⁴ 楊義

⁵ 周義山

⁶ 桑田

⁷ 泰山

⁸ 洞神八帝妙精經

⁹ 初神丸

¹⁰ 勿反顧

¹¹ 茅山派

¹² 孫思邈

¹³ 三蟲

¹⁴ 上清經

¹⁵ 魏華存

¹⁶ 孟詵

¹⁷ 洞神八帝元靈經

¹⁸ 紫陽真人內傳

¹⁹ 王遠

²⁰ 許謐

²¹ 食療本草

²² 蔡經



Fig. 1321. Ma Ku, her brother Wang Yuan, and Tshai Ching; from the *Lieh Hsien Chhüan Chuan*, ch. 3, p. 24a.

Thus all in all there is much reason for thinking that the ancient Taoists experimented systematically with hallucinogenic smokes, using techniques which arose directly out of liturgical observance.^a There may well have been a close connection here with the fungal hallucinogens already discussed (p. 116 above), and equally another with the anoxaemic and other abnormal states intentionally produced in some of the exercises of physiological alchemy (pt. 5 below). Even hypnotic and trance techniques are not to be excluded, and later on we shall find many examples of adepts and alchemists who clearly impressed their clients and contemporaries by their strange or charismatic personalities (in Vol. 5, pt. 3). At all events the incense-burner remained the centre of changes and transformations associated with worship, sacrifice, ascending perfume of sweet savour, fire, combustion, disintegration, transformation, vision, communication with spiritual beings, and assurances of immortality. *Wai tan* and *nei tan* met around the incense-burner.^b Might one not indeed think of it as their point of origin?

(8) NOMENCLATURE OF CHEMICAL SUBSTANCES

Returning now to more mundane matters, something ought finally to be said about the way in which minerals, ores and chemical substances got their names in Chinese. Since these names and terms naturally occur with frequency during the rest of this volume, such a brief survey could not further be postponed. Table 95 provides a general list of the nomenclature found in ancient and medieval Chinese texts, roughly chronologically arranged within each entry, and including some comparisons with Western (Greek and Latin) terms of similar date. It goes without saying that since the scientific revolution did not take place in Asia, no modern system of chemical nomenclature ever developed indigenously in China, though a great effort was eventually made to acclimatise the generally accepted modern notation and terminology within the Chinese language.^c What is worth doing here is to look at Table 95 and to select from it certain chemical names which illustrate the principles on which the naming was, through the ages, done. For brevity we exclude consideration of the numerous fancy poetical alchemical cover-names, and consider only those terms which were used by alchemists, technologists, pharmacists and metal-workers in common.^d

First we should think of terms formed by single characters. Although it might have been convenient to have had many of these, such coinages usually took place in fairly

red-hot stones, whereupon they became very joyful and excited. Moreover in the next sentence Herodotus goes on to say that the Scythian women make a paste of cypress, cedar and frankincense, anointing themselves withal, by the aid of which they gain a sweet odour and a glossy skin. One feels that Herodotus did not quite grasp the whole of what was going on.

^a It remains to be seen whether other plant hallucinogens also might not have been suitable for group inhalation in the Taoist oratories.

^b We do not wish in any way to minimise the role of the metal-workers and the potters, with all their lore of natural magic, in the development of Chinese alchemy; but a distinctively religious motif, not derived from them, was outstandingly important in both *wai tan* and *nei tan* from the beginning. So it was, for that matter, *mutatis mutandis*, in the aurification of the early Hellenistic proto-chemists.

^c See the last sub-section in Vol. 5, pt. 3 below.

^d We have touched upon this subject already in Vol. 3, pp. 641 ff., in connection with mineralogical nomenclature. Cf. the discussion of Sivin (1), pp. 306ff.

remote antiquity, and therefore had been prior to the need for any sophisticated nomenclature for inorganic or organic substances; consequently no very great number of them existed in the language until the incorporation of modern chemistry.^a More common was the phraseological method of forming names by joining two or three characters together in indissoluble chains; of this we shall find many examples. In both cases inventiveness drew primarily on the radicals *shih*¹ (stone, no. 112), *yü*² (jade, no. 96), *chin*³ (metal and alloy, no. 167), *yu*⁴ (fermented liquid, no. 164) and, for powders, *mi*⁵ (rice grains, no. 119). Among the ideographic coinages one can point to such words as *phi*⁶ for arsenic trioxide (no. 17),^b or *thou*⁷ for brass (no. 29), or *ma*,⁸ in a doublet as *ma-nao*,⁹ for agate (no. 5); and among the more complicated forms one could mention *fan*¹⁰ for alum (no. 6) and *yü*¹¹ for arsenolite (no. 18). It must of course be understood that these were mostly determinative-phonetic in nature rather than pictographic or ideographic in the strict sense,^c though in some cases the phonetic seems to have been chosen with particular appropriateness, as in the 'hedge' or evaporation tower which surmounts the 'stone' in the character for alum.^d An available radical which might have been made more use of was *lu*¹² (salt, rad. no. 197), but it had to wait for an expansion of derivatives until modern times, though several instances of its use are listed in Table 95. Special cases occur particularly in Taoist writings, such as the expressive *hung*¹³ for mercury, and their peculiar orthograph of *chhi*¹⁴ (*pneuma*) as *chhi*,¹⁵ where 'a puff of air' hovers above 'fire'. Its mysterious radical (rad. no. 71) 'nothing-ness' was one which had almost no derivatives at all, but the fact that *chi*¹⁶ meant a belch or a hiccup certainly suggests a link with the similar puffs of air or vapour due to Nature rather than to man. Of the phraseological joining together only a couple of examples need be taken, *shih chih*,¹⁷ 'stone-fat' for clays of various kinds (Table 95, no. 7), and *shih mien*,¹⁸ 'stone floss or wool' for asbestos (no. 20). Beside specific names like these, one could say that in general powders tended to be known as *sha*^{19, 20} (sands), *hui*²¹ (ashes), *fên*²² (from finely divided rice meal), and *thang*²³ (sugars). Sublimates were liable to be *shuang*²⁴ (frosts) or *hsüeh*²⁵ (snows), and amalgams *ni*²⁶ (muds). Other pasty substances were called 'fats' (*chih*,²⁷ *kao*²⁸), as we have already seen in the name for clays. Almost any prepared chemical could be a *tan*,²⁹ the term properly belonging to cinnabar (no. 122) which must also often be translated 'elixir'.^e

By reason of the nature of the case the doublet or triplet name-phrases for minerals and chemicals were less rich than the botanical nomenclature which we consider in Sect. 38. Nevertheless of the fourteen name-motivations which we list there, eleven can be exemplified from the chemical field. These are (1) shape and pattern, (3) colour,

^a Special characters were then formed for each of the chemical elements.

^b These numbers refer to the entries in Table 95.

^c For further explanation see Vol. 1, p. 30.

^d This has already been discussed in Vol. 3, pp. 642, 653.

^e Cf. p. 157 on colour ideographs, for *tan* can also mean simply red.

1 石	2 玉	3 金	4 酉	5 米	6 砒	7 鎗
8 瑪	9 瑪瑙	10 礬	11 礬	12 鹵	13 汞	14 氣
15 汞	16 无	17 石脂	18 石棉	19 砂	20 沙	21 灰
22 粉	23 糖	24 霜	25 雪	26 泥	27 脂	28 膏
29 丹						

(4) aroma, (5) taste, (6) special properties and characteristics, (7) habitat, (8) geographical origin, (11) sex, (12) use, (13) patronymic, and (14) foreign origin. In addition we need here a further category, (15) artificial chemical preparation. Let us give an example or two of each of the types.

Shape and pattern can be noted in *li shih*¹ (veined gypsum or alabaster, no. 34), in *mao ching*² (cat's-eye, cymophane, beryllium aluminium oxide, no. 38) and in *mang hsiao*³ ('spike-solve', magnesium sulphate, no. 116) because of its acicular crystal form. To these one might add the interesting *tou chin*,⁴ 'bean gold', for stannic sulphide (no. 167), because of the concretions in which it was recovered after preparation. Colour is obvious in *pai chhing*,⁵ the pale blue mineral, for azurite (basic copper carbonate, no. 23), in *tsu shih ying*⁶ for purple quartz (no. 9), and above all in *shih liu huang*⁷ or just *liu huang*,⁸ the 'flowing yellow' for sulphur (no. 169). Aroma, or 'stinks', could be illustrated perhaps from one of the terms for sal ammoniac and ammonium carbonate, *chhi sha*,⁹ the 'pneuma-producing sand' (no. 10).^a Taste, finally, is evident in the term for vitriol par excellence, blue vitriol, copper sulphate, *shih tan*,¹⁰ 'stone-gall' (no. 56), testifying to its strongly caustic, astringent and emetic quality.

Special properties and characteristics are readily illustrated. One could think of magnetic iron oxide (no. 117) as *tsu shih*,¹¹ 'loving stone' (as in the Gilbert and Sullivan lyric), or (anciently at least) as *hsüan shih*,¹² the dark or mysterious stone. So also potassium nitrate was 'solve-stone', *hsiao shih*^{13, 14} (no. 140), partly because it could help the melting of metals by acting as a flux, partly because it could aid (by the formation of weak nitric acid) the solution of many other mineral substances. A third example could be *meng huo yu*¹⁵ for low boiling-point petroleum fractions (naphtha, no. 129), appropriately 'fierce fire oil'. Names from 'habitat' are less common, but 'contrary stone', *ni shih*,¹⁶ was a good one for the calcite of stalagmites as opposed to stalactites (no. 166), and *shih nao*¹⁷ or 'stone brain' was descriptive enough for geodes or globular masses of haematite, etc., containing loose nodules (no. 81). The role of sex was less marked among the minerals than among the plants,^b but two especially prominent chemical substances were thus distinguished, *hsiung huang*¹⁸ or 'male yellow' for arsenic disulphide (realgar, no. 15) and *tsu huang*¹⁹ or 'female yellow' for the trisulphide (orpiment, no. 16).

Names from use might be exemplified from *sui shih*,²⁰ the lamp-lighting stone (no. 78), for flint (and steel);^c or from *hu fén*,²¹ 'paste, or ointment, powder', for basic lead carbonate (ceruse, no. 110) on account of its use from very ancient times as a white cosmetic (cf. pt. 3). Eponymous appellations occur in *yü yü liang*,²² 'the remains of lunch left behind by Yü the Great', for haematite (no. 68); and the term *ling-yang*

^a Main constituent of 'smelling-salts' (Hiscox (1), pp. 510, 628). Cf. p. 90 above.

^b Though of course all substances were either Yin or Yang. Cf. Vol. 5, pt. 4

^c On the background of this see Vol. 4, pt. 1, pp. 87ff.

¹ 理石

² 貓睛

³ 芒消

⁴ 豆金

⁵ 白膏

⁶ 紫石英

⁷ 石流黃

⁸ 硫黃

⁹ 氣砂

¹⁰ 石膽

¹¹ 慈石

¹² 玄石

¹³ 消石

¹⁴ 硝石

¹⁵ 猛火油

¹⁶ 逆石

¹⁷ 石腦

¹⁸ 雄黃

¹⁹ 雌黃

²⁰ 遼石

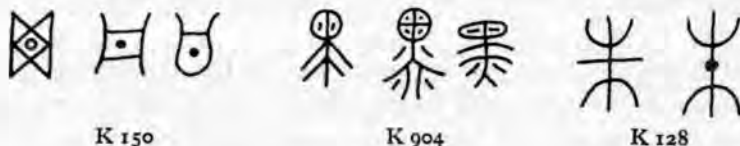
²¹ 齒粉

²² 禹餘糧

*tsu-ming*¹ for mercury (no. 125), which is nothing but the name of a semi-legendary alchemist (pt. 3). Lastly, among names implying foreign origin, apart from transliterations of foreign words which naturally form a group to themselves, we can instance *hui hui chhing*² or 'Muslim blue' for cobalt oxide (no. 42), an important colouring-matter for the porcelain industry which was originally imported from Central or West Asian countries, but in later times derived from deposits discovered within China.

There remains only a number of terms which say something about the method of preparation of the product. 'Bean gold' was in a way like this, but a better instance would be *fei hsieh tan*³ or 'flying snow chemical' for calomel (mercurous chloride, no. 123) and 'white quelled chemical', *pai hsiang tan*,⁴ for corrosive sublimate (mercuric chloride, no. 121). The curious name for brass, *thou-shih*⁵ (no. 29), might also come in this category, for it originated from the fact that the zinc was added in the form of its salts to the molten copper or copper alloy, hence the added word *shih*. This is probably as much as we need say about the ways in which the traditional nomenclature of minerals and inorganic chemical substances grew up in Chinese culture.

In approaching a subject such as this, it is always tempting to cast a glance at the possible etymologies of some of the most important words concerned. In chemistry the colours are among the deepest and oldest needs which must have been felt in description, so we may see what has been said of them.^a First *tan*,⁶ red or cinnabar colour, has been thought to be a drawing of a globule of mercury on a pan (K 150, see illustration below), and this is not impossible, though it would put the first knowledge of quicksilver much earlier than we have dared to date it. Others have seen a lump of



K 150

K 904

K 128

mineral in a crucible, or a mineral powder on a stretched filter-cloth,^b and this is perhaps more likely. The pictograph for *hei*,⁷ black, has been thought to show a pair of soot-collecting vessels over a flue or chimney, presumably for the making of ink (K 904), and Hsü Shen certainly saw the fire and the chimney or smoke-hole in it; but Karlgren prefers to interpret it as a drawing of a human figure with face and body covered with spots of dark war-paint. Concerning *chu*,⁸ again red, there is general agreement, however, namely that the picture portrays a tree from the trunk of which, like sappan or haematoxylin, a red dye-pigment is obtained (K 128). Similarly, for *chhing*,⁹ blue-green, there is not much doubt that the pictograph shows a plant of some

^a The subject has been specifically considered by Kelling (1), p. 61. We draw too upon Jung Kêng (3), Chang Hsüan (1) and Karlgren (1).

^b Cf. Mahdihassan (16), pp. 22-3.

¹ 陵陽子明

² 回回青

³ 飛雪丹

⁴ 白降丹

⁵ 鎗石

⁶ 丹

⁷ 黑

⁸ 朱

⁹ 青

kind, very possibly indigo, with its juice being collected in a pan (K812, *c'*, *d'*). Yellow, *huang*,¹ is hard to interpret, and Karlgren regards its meaning as quite uncertain; one guess is as good as another, e.g. a tattooed man carrying a packet of nuggets of yellow gold (K707); or, as Kuo Mo-Jo suggests, a drawing of patterns on yellow jade. Finally, *hsüan*,² blue-black, in one form seems to be a serpent or a human being hidden under some cover, while in another it is the usual hank of silk to which the main part of the character corresponds, doubtless in this case dyed black or blue-black (K366). Finally, it is noteworthy that all other colour terms have the textile radical, which shows that they must have been derived from dyeing.^a



As for their systematisation over the ages, we shall mention below in the historical sub-sections as we go through them successive examples of lists and glossaries from the -4th century onwards. The Pên Tshao literature, i.e. the pharmaceutical natural histories, was prominent in this, and it included several works especially devoted to the iatro-chemistry of the inorganic world (cf. Vol. 5, pt. 3). Here perhaps it is necessary only to mention the single greatest lexicographic effort of this kind, Mei Piao's³ *Shih Yao Erh Ya*⁴ (The Literary Expositor of Chemical Physic), a synonymic dictionary of minerals and chemical substances mostly with medical uses, finished in +806.^b But many alchemical books have reasoned lists.

It may well be asked at this point how secure one can feel in accepting the identifications of chemical substances under their particular traditional Chinese names. The answer is that over the past two centuries a considerable body of assured knowledge has been built up by comparative studies, partly literary in character, but also directly observational and experimental, using collections of chemical substances made from the very drugstores, surgeries and workshops of China themselves. Tradition has thus been confirmed—and occasionally modified—by modern chemical analysis. The story is worth telling. First there were the activities of the Jesuits in the +17th and +18th centuries, especially those who had an interest in chemistry, such as P. M. Cibot and J. P. L. Collas during the seventeen-seventies and eighties, but they never had a chance to carry on systematic work, nor did anything of that kind originate from the publications of their colleagues in Europe.^c Things did not really begin to move until about 1800.

^a It would be equally interesting, and speculative, to study the ancient words for various kinds of vessels—but we forbear.

^b TT894. This is fully described in pt. 3 below.

^c The reasons for the futility of the Jesuit mission in chemistry, so much contrasting with their brilliant success in mathematics and astronomy, we discuss in detail later, also in pt. 3.

¹ 黃

² 玄

³ 梅彪

⁴ 石藥爾雅

Let us look first at the more literary work, accompanied as it was later on to a growing extent by first-hand acquaintance with the actual products of Chinese chemical and pharmaceutical industry, then turn to consider the remarkable tale of the specific collections. The modern period might be said to open with Hugh Gillan, the physician who accompanied the Macartney Embassy, for on his return in +1794 he wrote down his 'Observations on the State of Medicine, Surgery and Chemistry in China'. As might be expected from the period, and from the time at his disposal, these were both superficial and supercilious, but since in any case they contained only a few names of chemical substances recognisable through the strange romanisation, and as they remained in manuscript until printed by Cranmer-Byng (2) in our own time, they contributed very little to the mutual understanding of cultures. Much more solid work was done by Rémusat in 1827, when he made a précis translation, or *catalogue raisonné* of headings, of many of the chapters of the *Wakan Sanzai Zue*¹ (Chinese and Japanese Universal Encyclopaedia) edited by Terashima Ryōan² in +1712, an enlargement of the original *San Tshai Thu Hui* which Wang Chhi³ and his son had issued in +1609. Rémusat's work included chs. 59, 60 and 61 on metals, gems, ores, minerals and chemical substances;^a and seventy years later these were reproduced in facsimile and integrally translated by de Mély (1), in a work still useful today. Then in 1867 Pfizmaier (95) produced one of his dead-pan translations of the *Thai-Phing Yü Lan* (chs. 807 to 811) on gems and precious metals, while twenty years later Bretschneider (2) translated a list of West Asian gems from the +14th-century *Cho Kêng Lu*.^b

The next wave came from the Anglo-Saxons present in China or Japan as missionaries or scientists during the second half of the nineteenth century. Porter Smith's 'Contributions towards the Materia Medica and Natural History of China...', which appeared at Shanghai in 1871, was based on first-hand acquaintance with inorganic substances as the Chinese used them. In a separate paper (2) he paid special attention to the Chinese chemical manufactures. Actually he had been anticipated to some extent by that most learned pharmaceutical chemist Daniel Hanbury, who in 1860-2, working in the less exotic surroundings of Clapham, learnt enough Chinese to study intelligently the chemicals of China, obtained by him from correspondents there.^c A revised version of this work (1) appeared posthumously in 1876. By then Doolittle (1) had incorporated in his Chinese vocabulary, printed at Fuchow in 1872, several glossaries of chemical terms.^d Meanwhile the Dutch scholar, A. J. C. Geerts, who had

^a Though Rémusat knew the collection of Vandermonde, on which see pp. 160-1 below, there were many mistakes and uncertainties in his lists.

^b A French translation is in de Mély (1), pp. 251 ff.

^c The identifications were mostly very just, and accompanied by some analyses; they included some substances relatively recent in date for Chinese chemistry, such as mercuric nitrate (*hung shêng yao*⁵ or *huang shêng yao*⁶), as well as those traditionally familiar. Hanbury's brother Thomas visited China.

^d Chemistry was done by J. G. Kerr, mineralogy by W. Muirhead, and photography by John Thomson and John Dudgeon. By this time they were able to draw upon the developing modern Chinese chemical terminology (cf. pt. 3 below). A few Chinese chemical names and terms had already appeared in the chrestomathy of Bridgman & Williams (1), published at Macao in 1841.

¹ 和漢三才圖會

² 寺島良安

³ 王圻

⁴ 輟耕錄

⁵ 紅升藥

⁶ 黃升藥

gone out to a chair at the new Medical School at Nagasaki in 1859, was working on a systematic study of Japanese and Chinese natural products; the result of this was an uncompleted treatise in two volumes which came out at Yokohama in 1878 and 1883. It took the form of a paraphrase and commentary of the inorganic chapters of the *Pên Tshao Kang Mu* based on Ono Ranzan's¹ commentary in Japanese, and Geerts undoubtedly had a good first-hand knowledge of the chemical substances on which he wrote, hence his book is still valuable and usable.

After this there was another pause, until the twenties of the present century. Then in 1921 Chang Hung-Chao (1), working under the auspices of the youthful and vigorous Chinese Geological Survey, produced his book entitled *Shih Ya*² (Lapidarium Sinicum; or, the Literary Expositor of the Lithic World), a work which with great erudition discusses the whole nomenclature of inorganic substances from the beginning, and which, in spite of all deficiencies, remains to this day an authority of the first importance.³ Simultaneously Bernard Read & Pak Kyebyöng, a Korean, staff members of the Lester Institute in Shanghai,⁴ were working on their survey of the minerals and chemicals of the *Pên Tshao Kang Mu*, a mine of information both lexicographic and analytic which appeared first in Peking in 1928. This again is still indispensable.⁵

Clearly many of the men we have mentioned were extremely familiar with the chemical substances used in China and with their standard Chinese names, but of course they all stood at the near end, as it were, of a tradition two millennia old. Could it be possible to fix a few other points on the graph of time, one might wonder, and verify in some way the association of names and substances in former centuries? This has indeed been possible in three remarkable cases, and we must now describe them.⁶

In +1720 a French physician, Jacques François Vandermonde, went out to Macao and practised there for a dozen years, during which time he made a stay upon the island of Poulo Condor. At one or the other place, during the year +1732, he made a collection of 80 specimens of inorganic chemicals following the entries in the *Pên Tshao Kang Mu* (and amounting therefore to about 60% of the total), each of which he labelled with the name in Chinese characters and romanisation. He also prepared a MS. catalogue, entitled 'Eaux, Feu (et Cautères), Terres, etc., Métaux, Minéraux et Sels, du *Pên Tshao Kang Mu*';⁷ this is a very incomplete translation of the Chinese text, with no attributions of the sources quoted by Li Shih-Chen, and a special interest

¹ It may now be supplemented by the opinions of Masutomi Kazanosuke (1), pp. 180ff.

² This was the first scientific home of one of us (G.D.L.).

³ Not however, emphatically, to be taken uncritically, as can be seen only from its various internal contradictions. Among the many analyses of chemicals which had been made during the preceding years one might mention the papers of Neal (1); Douthwaite (1) and Read & Li (1).

⁴ One may always hope that future archaeological investigations will provide yet further opportunities of a similar kind.

⁵ Such at least is the content of the paper. We have not seen it, and suspect that now at least it has no title.

¹ 小野蘭山

² 石雅

in the medical applications, but also including Chinese characters.^a Upon his return to Paris not long afterwards, he presented the whole to Bernard de Jussieu, who deposited the collection in the Musée d'Histoire Naturelle but kept the manuscript; this too however found its way to the Museum in 1857 when it was acquired from the de Jussieu family. The samples were analysed for E. Biot in 1839 by his friend the chemist Alexandre Brongniart, and the results published in the same year (Biot, 22). Here then we have a most valuable point on the graph dating from the early eighteenth century.

Just about a thousand years previously events had occurred in Japan which led to the preservation of a collection in some ways quite similar. In +756 on the occasion of the death of a Japanese emperor, Shōmu¹ (r. +742 to +748), his widow decreed the establishment of a great treasure-house which should perpetuate his memory by enshrining for ever the most beautiful and valuable objects which the court possessed. For ever is a long time, but such is Japanese conservatism that the Shōsōin² in the grounds of the Tōdaiji³ temple at Nara⁴ has lasted down to the present day, and the drugs in it, both mineral and vegetable, have been studied by modern scientific methods. Among the 600 treasures there were 60 specimens of medicines, not intended quite like the other things for perpetual preservation but as a stock to be drawn upon for the benefit of the sick poor; withdrawals for this purpose ceased, however, towards the middle of the +9th century. The original MS. catalogue of the drugs, based on the entries in the *Hsin Hsiu Pên Tshao* of +659, has survived, signed by four great officials, the first being Fujiwara Ason Nakamaro, Chief Administrator of the Court.^b Pharmaceutical inventories also remain from +787, +793, +811 and +856, while further additions were made in +950.^c It was for long unique in the world that an ancient collection of such high authenticity should be available for study, and the results can profitably be obtained from a number of publications, ranging from earlier papers such as those of Dohi Keizō (1, 1) in 1932 to the definitive work edited by Asahina Yasuhiko (1) in 1955 and the special study of the inorganic chemicals by Masutomi Kazunosuke (1) a couple of years later. But by a strange coincidence, in that same year of +756, a Thang prince, fleeing from rebellion, buried at Chhang-an a treasure hoard which, only recently discovered, includes at least a dozen silver boxes containing labelled chemicals (Fig. 1335).^d Thus besides all the identifications of Chinese chemical names established in this century we have also three series of verifiable terms from the mid +8th and the early +18th. With this we offer Table 95.

^a It was printed in 1896 by de Mély (1), pp. 156-248. De Mély remarked that Vandermonde was the first sinologist before Geerts who understood that it was impossible to discuss a Chinese inorganic substance without having before one the actual characters of its name. True indeed, but Hanbury and perhaps Porter Smith deserve the merit before Geerts.

^b A facsimile of this document is appended to Asahina (1).

^c All the drugs were of Chinese origin except six, which were clearly from the Southern regions, and eight more which could have been indigenously Japanese.

^d See Hsia Nai *et al.* (1), pp. 3 ff.; Anon. (115), p. 2; Wang Yeh-Chhiu *et al.* (1), p. 32. This was the hoard which contained alchemical apparatus such as silver aludels and a silver ladle with a collapsible handle (see Vol. 5, pt. 4). Sassanian, Byzantine and Japanese coins dating from +590 to +708 were also present; cf. Anon. (106), pl. 69, A, B, C, and Kuo Mo-Jo (8).

¹ 聖武

² 正倉院

³ 東大寺

⁴ 奈良

Notes for Table 95

Nomenclature of chemical substances, ores and minerals in the old Chinese literature

(1) This list equates the technical names of ores, minerals and chemical substances (mainly inorganic), found in old Chinese books, with their modern names and those most common in European literature from Hellenistic times down to the Renaissance and the rise of modern chemistry.

(2) The columns are arranged in the following sequence:

(a) the modern name of the substance, in its alphabetical order, with mining or other synonyms, and cross-references.

(b) references to the literature on which the identifications are based.

Abbreviations are as follows:

- A Asahina Yasuhiko (1), item number
 B Bretschneider (1), item number
 C Chang Hung-Chao (1), page number
 G Geerts (1), entry number
 L Laufer (1), page number
 M de Mély (1), page number
 MK Masutomi Kazunosuke (1), page number
 R Read (1), entry number
 RP Read & Pak (1), entry number
 S Sivin (1), page number
 V Vandermonde, in de Mély (1), page number.

Occasional references give the author's name in full, e.g. Laufer (13). The mark (P) indicates that the substance appears in the list of Assyrian-Babylonian chemicals drawn up by Partington (1), p. 317. Cf. the papers of Boson (1, 2) as well as Campbell Thompson (5) and the literature condensed by Partington.

(c) the chemical nature of the substance, with any explanations necessary.
 (d) the ancient and medieval European names. Latin and Greek terms have been derived from Berthelot (2), Partington (1), Stapleton (1), and particularly from the work of K. C. Bailey (1) on Pliny's *Natural History*. Terms followed by the sign (A) are derived from Agricola (Hoover & Hoover edn.) and represent late medieval tradition.

(e) the Chinese names at different periods, ranging from the earliest list (*Chi Ni Tzu*) probably of the 4th century, down to the *San Tshai Thu Hui* of +1609.

(3) Here follows the key for the identification of the Chinese sources:

SHC	<i>Shan Hai Ching</i>	—	—	8th to — 1st
CN	<i>Chi Ni Tzu</i>	Chi Jan	—	— 4th
SN	<i>Shen Nung Pên Tshao Ching</i>	—	—	— 2nd and — 1st
			finalised in	+ 1st and + 2nd
LH	<i>Lun Heng</i>	Wang Chung	—	+ 83
HS	<i>Chhien Han Shu</i>	Pan Ku	—	+ 100
SW	<i>Shuo Wen Chieh Tzu</i>	Hsü Shen	—	+ 121

TT	<i>Tshan Thung Chhi</i>	Wei Po-Yang	+ 142
PWC	<i>Po Wu Chi</i>	Thang Mêng	+ 190
PP	<i>Pao Phu Tzu</i>	Ko Hung	c. + 320
MI	<i>Ming I Pieh Lu</i> and <i>Pên Tshao Ching Chi Chu</i>	Thao Hung-Ching	c. + 495
YH	<i>Pên Tshao Yao Hsing</i>	Chen Li-Yen & Chen Chhüan	c. + 620
TCY	<i>Tan Ching Yao Chüeh</i>	Sun Ssu-Mo	c. + 640
TP	<i>Thang Pên Tshao</i> (i.e. <i>Hsin Hsiu Pên Tshao</i>)	Su Ching (Su Kung) et al.	+ 659
SI	<i>Pên Tshao Shih I</i>	Chhen Tshang-Chhi	c. + 725
SY	<i>Shih Yao Erh Ya</i> (TT 894)	Mei Piao	+ 806
HY	<i>Hai Yao Pên Tshao</i>	Li Hsün	c. + 923
TF	<i>Tan Fang Chien Yuan</i> (TT 918)	Tuku Thao	c. + 950
JH	<i>Jih Hua Chu Chia Pên Tshao</i>	Ta Ming (Jih Hua Tzu)	c. + 972
KP	<i>Khai-Pao Pên Tshao</i>	Liu Han, Ma Chih et al.	+ 973
WT	<i>Wai Tan Pên Tshao</i>	—	c. + 1040
CY	<i>Chia-Yü Pên Tshao</i>	Chang Yü-Hsi et al.	+ 1057
TC	<i>Pên Tshao Thu Ching</i>	Su Sung et al.	+ 1061
CL	<i>Chêng Lei Pên Tshao</i> (first version)	Thang Shen-Wei	+ 1083
MC	<i>Mêng Chhi Pi Than</i>	Shen Kua	+ 1086
KM	<i>Pên Tshao Kang Mu</i>	Li Shih-Chen	+ 1596
ST	<i>San Tshai Thu Hui</i>	Wang Chhi	+ 1609

(4) The usual literary dictionaries could not substitute for the present glossary, partly because the real meanings of terms only emerge from prolonged study of the technical texts, and partly because dictionaries do not show all inorganic chemical substances, ores and minerals together. This list furnishes a conspectus of what the ancient and medieval Chinese alchemists and chemical technologists had upon their shelves. It is therefore designed to promote an understanding of their possibilities and limitations. It makes no claim, however, to be exhaustive, and the identifications must still be taken with every reserve. At the same time, owing to the timely collection of specimens by Vandermonde in the eighteenth century (cf. p. 160), we still participate in the living tradition of the Chinese alchemists and pharmacists. Similarly, the analyses of the specimens preserved intact since +756 in the Shōsōin Treasury at Nara in Japan have given most valuable confirmatory information. And now we have the labelled specimens from Chhang-an dating from the same year.

(5) A few entries will be noted for which no Chinese equivalents are given; these are inserted for special reasons, such as explanation of confusions in the European terms.

(6) A certain number of names of precious stones and gems are included, even though they probably entered into alchemical preparations only infrequently. The terminology of this class of substances is very complicated and somewhat confusing, but much light has been thrown upon it by the researches of Chang Hung-Chao (1); Bretschneider (2), and others.

(7) A few items of plant or animal origin, if concretions or fermentation products, etc., are included. Acetic acid and alcohol were perhaps the most important (cf. Vol. 5, pt. 4), but cyanide seems to have been obtained from certain plant sources.

(8) It is important to realise that this table, ample though it may seem, is only the tip of an iceberg of technical terminology. Even to include all the alchemical synonyms or cover-names that we think we understand would double or triple it, and the whole language composed of them would quadruple that again. An immense amount of elucidatory work remains to be done. Nor is it easy to be sure, even from Mei Piao's +9th-century synonymic dictionary of minerals and drugs, the *Shih Yao Erh Ya*, what at any given time was the main name of a given substance and what were the synonyms. It will be noted that most of the SY entries are allegorical-alchemical names. But recourse to Mei's book will not always explain terms used, for instance, by Ko Hung. Undoubtedly there were many schools and traditions in Chinese alchemy, probably each with its own set of technical terms. Everywhere oral tradition was operative, and personal instruction of the disciple by the master was essential. This is stated in so many words by Ko Hung in two important passages (chs. 2 and 16 of *Pao Phu Tzu*; cf. Vol. 5, pt. 3) on oral tradition (*khou chieh*).¹

(9) As will be seen from the authorities, distinguished by a code of initials, which we have attached to most of the chemical names, the list in this table does constitute an attempt to show how the terminology changed, and at what times which appellation was mostly in use. But here again much reserve is necessary, and one must remember that there was a great deal of overlap, some terms continuing long as synonyms of others, some dying out and some being newly introduced, others again positively reversing the meaning which they had had before. A great deal more work will be necessary before we can see the ancient and medieval Chinese chemical terminology in full perspective detail, so as to be sure exactly what a particular alchemist meant by the descriptions which he gave at a particular time.

(10) The task of estimating exactly how many individual substances were known to chemists at different times, e.g. to the +2nd-century author of the *Tshan Thung Chhi*, is very difficult, on account of the abundant use of alchemical cover-names and fanciful synonyms which may or may not cloak a conscious identification. Nevertheless, future research may be expected to make much

progress in this direction. There is also the difficulty that different names were applied, as by *Pên Tshao* authors, to varieties of the same substance coming from different geographical locations, and presenting superficial differences of colour, etc. We have excluded from the table those names which depended purely on geographical origin, e.g. *Kua-chou fan*,² ferrous sulphate from the alum of Kuachow, near modern Tunhuang. Moreover there were wide variations of local custom in appellations, both as to the name used and to the way it was pronounced.

(11) It will be noticed that there are some cases of considerable overlap, the same name (e.g. *han shui shih*)³ being applied to three or four poorly distinguished minerals. This was inevitable before the rise of modern chemistry and mineralogy. But in other cases remarkable progress was made in the separation and recognition of salts by differential crystallisation (cf. pt. 4).

(12) The 'modern' Chinese names given are generally the common ones current in the nineteenth century, but they did not necessarily originate as late as that, and one can expect to come across them in any century back to the Tang or before.

(13) Contemporary Chinese scientific terms are not included, as they may be found in the usual technical dictionaries. As for the elaboration of the nomenclature and terminology of modern chemistry in China, see pt. 3.

(14) Most of the substances named and identified in the table were of course generally very impure, both in China and the West. But there were certain exceptions to this, for example sublimed arsenious acid crystals (de Mély (1), p. 231), and sulphur, ferrous sulphate, and potash alum (Read & Pak (1), pp. 70 ff.). In other cases, such as mercury, the nature of the substance would imply that a rather pure product was obtained as soon as it was obtained at all. On this question, see the papers of Neal (1), Douthwaite (1), and Read & Li (1), who found some fifteen substances available on the traditional market in highly purified state. A further point always to be remembered in considering pharmacological actions, whether intentional or otherwise, is that the presence of trace elements, both in naturally occurring and semi-purified substances, may sometimes have been particularly important.

(15) While it would clearly be impossible to refer here to all the nomenclatural glossaries of substances which have been drawn up for other culture-areas, it may be helpful to note one or two. For the European the most recent and complete is that of Goltz (1). Many Hellenistic substance terms will be found annotated in Berthelot (2), i.e. Berthelot & Ruelle (1), vol. 1, pp. 228 ff. Similarly for the Arabic names of substances (*'aqāqir*) there is, besides the dictionary of Siggel (2), much information in Stapleton & Azo (1), pp. 55 ff.; Stapleton, Azo & Husain (1), pp. 321 ff., 345 ff., 363 ff. and 369 ff.

¹ 口訣

² 瓜州礬

³ 寒水石

Table 95. *Nomenclature of chemical substances, ores and minerals (with inclusion of certain chemicals of organic origin)*

abrasives, <i>see</i> corundum, diamond, garnet, quartz, sand				
1 Abraum salt, e.g. polyhalite	A 7	mixed sulphates of calcium, mag- nesium and potassium, $2\text{CaSO}_4 \cdot \text{MgSO}_4 \cdot \text{K}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$		<i>han shui shih</i> 寒水石
2 acetic acid (vinegar; perhaps sometimes concen- trated, cf. pt. 4)	S 291, 293	$\text{CH}_3 \cdot \text{COOH}$	acetum	PP: <i>tsho</i> 酢 <i>tshu</i> 醋 (if conc.) <i>yen tshu</i> 醃醋 (if with other substances in solu- tion) <i>khu chiu</i> 苦酒 other terms: <i>hua chhih tso wei</i> 華池左(佐)味, <i>tso wei</i> 左(佐) 味, <i>tshu chiang shui</i> 醋漿水 SY: KM: <i>yang chhi shih</i> 陽起石 <i>shih mien</i> 石綿
3 actinolite (certain varieties of which form amphi- bole asbestos, tremo- lite, hornblende, etc.)	Hansford (1) M 105 MK 198 RP 75 S 293 V 220	Calcium and magnesium silicate (often fibrous) coloured green or brown by iron. $\text{Ca}(\text{Mg}, \text{Fe})_3(\text{SiO}_3)_4$		
4 agalmatolite (pyrophyllite)	C 152	hydrous aluminium silicate $\text{Al}_2\text{Si}_4\text{O}_{10}(\text{OH})_2$ (similar to steatite, q.v.)		<i>shou shan shih</i> 壽山石
5 agate	RP 34 C 34, 148, G 97, M 56, V 182	silica, micro-crystalline silicon dioxide (SiO_2) with precipitates of other com- pounds, often in Liesegang rings	gagates	SW: <i>chhiung kuei</i> 瓊瑰 CY: KM: ST: mod: <i>ma-nao</i> 瑪瑙 ST: <i>lang-kan</i> 琅玕
alabaster, <i>see</i> calcium sulphate	A 56			
6 alum (cf. Vol. 3, pp. 653-4)	C 170-1 M 145 MK 181 RP 131 S 276, 279 V 247 Singer (8)	hydrated double sulphates of aluminium and a monovalent metal (e.g. potash alum, $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$) <i>kalinite</i> ; or <i>halotrichite</i> (if K replaced by Fe), <i>pickeringite</i> (if K replaced by Mg); <i>apjohnite</i> (if K replaced by Mn). The K may also be re- placed by ammonia, and this was the great artificial form used from the late Middle Ages on- wards in the West (cf. Sect. 34)	alumen, styptēria	SHC: <i>shih nieh</i> 石涅 CN: SN: PP: TF: KM: <i>fan shih</i> 礬石 PP: <i>pai fan</i> 白礬 SY: <i>shih tai</i> 石黛 <i>pi ling wēn hou</i> 碧陵文侯 ST: mod: <i>ming fan</i> 明礬 (if anhydrous) <i>khu fan</i> 枯礬
7 aluminium silicate, hydrated (<i>cimolite</i>)	C 169 RP 57	clays (often coloured by metallic salts), complex aluminium silicates	<i>cimolia creta</i> , <i>lapis palmatis</i> , <i>terra sigillata</i>	SHC: <i>shih nieh</i> 石涅 SY: KM: <i>wu sē shih chih</i> 五色石脂
aluminium sulphate, <i>see</i> alum				

8	amber	A 44 C 58, 152 Laufer (17)	fossil conifer gum	electrum	LH: <i>tun mou</i> 頓牟 HS: mod: <i>hu pho</i> 琥珀
9	amethyst (purple quartz)	C 149 G 78 MK 186 RP 41 S 292	crystalline silica (SiO ₂), with other compounds especially of iron and manganese	hyacinthus	SN: SY: KM: ST: mod: <i>tsu</i> <i>shih ying</i> 紫石英 SY: <i>hsi jung shun wei</i> 西戎淳味
10	ammonium chloride (sal ammoniac, cf. Vol. 3, pp. 654-5)	C 221 L 503 M 140 RP 126 S 283 V 246	NH ₄ .Cl. But, as among the Arabs, the carbonate was not clearly distinguished from the chloride	sal harmoniacus (medieval only)	TT: TP: SY: TF: KM: ST: <i>nao</i> <i>sha</i> 礲砂 SY: <i>nao sha</i> 礲砂 or <i>nao sha</i> 礲砂 mod: <i>lu sha</i> 礲砂 or <i>chhi sha</i> 氣砂
11	antimony (native)		Sb metal	stimmi femina, alabastrum	— KM: <i>hsi lin chih</i> 錫悒脂
12	antimony ore (arguerite, pyrrargyrite)	RP 3	double sulphide of silver and antimony (3Ag ₂ S.Sb ₂ S ₃)	stimmi or stibi larbasis, stimmi mas	ST: (perhaps) <i>hei shih chih</i> 黑石脂 mod: <i>thi kung</i> 錦鑛
13	antimony sulphide (stibnite)	Lucas (1), pp. 222 ff. RP 3	Sb ₂ S ₃		
	apjohnite, <i>see</i> alum				
14	apricot kernels argentite, <i>see</i> silver sulphide arguerite, <i>see</i> antimony sulphide	S 277	source of cyanide (<i>Prunus</i> <i>armeniaca</i> , R 444)		<i>hsing jen</i> 杏仁
15	arsenic disulphide (P?), (realgar, red)	A 41 C 211 G 53 M 79 MK 100-5, 156- 7, 181 RP 49 S 277 Schafer (6) V 202	As ₂ S ₂	sandaraca	SN: PP: SY: TF: KM: <i>hsiung huang</i> 雄黃 PP: <i>thai sun shou chung shih</i> 太筭首中石 SY: <i>huang nu</i> 黃奴 mod: <i>chi kuan shih</i> 鷄冠石
16	arsenic trisulphide (P), (orpiment, yellow)	C 211 G 52 M 80 MK 100-5, 186 RP 50 S 292 Schafer (6) V 202	As ₂ S ₃	arrhenicum, auripigmentum arsenicum	SN: PP: SY: TF: KM: <i>tsu huang</i> 雌黃 SY: <i>huang lung hsüeh shêng</i> 黃龍血生 <i>chhih chhu jou</i> 赤脣柔

Table 95 (continued)

17	arsenious oxide, arsenic trioxide (P?), (in solution, arsenious acid, H_3AsO_3)	G 51 M 118 RP 91 V 231	As_2O_3	arsenicum (A)	TF: mod: <i>phi</i> 砒 KP: KM: <i>phi shih</i> 砒石 or <i>phi shih</i> 砒石 ST: <i>phi shuang shih</i> 砒霜石 <i>pai hsueh</i> 白雪 SHC: SN: TT: PP: SY: KM: ST: <i>yü</i> 礬 or <i>yü shih</i> 礬石 SY: <i>chhiu shih</i> * 秋石 <i>chi-shih yü shih</i> 雞矢礬石
18	arsenolite (naturally occurring arsenic trioxide, white arsenic)	G 51 M 117 MK 198 RP 88, 89, 90 S 294 V 231	As_4O_6		
19	arsenopyrite (mispickel)	G 45 RP 7	$FeAsS$ or $FeS_2 \cdot FeAs_2$	<i>lapis subrutilus atque splendens</i> (A)	KM: <i>tsu-jan thung</i> 自然銅
20	asbestos, <i>see also</i> actinolite and tremolite (chrysotile)	M 85 RP 56	green fibrous magnesium silicate, $MgSiO_3$	amianthus	PP (and other ancient authors): <i>huo huan chih pu</i> 火浣之布 SY: KP: KM: ST: mod: <i>pu hui mu</i> 不灰木 mod: <i>shih mien</i> 石棉 mod: <i>ying shih yü</i> 硬石油
21	asphalt	Forbes (10) RP 69	non-volatile petroleum residues	ampelitis	
22	aventurine	C 152, 266 G 86 RP 42, 93, 94	translucent quartz spangled with scales of yellow mica		Sung onwards: <i>chin hsing shih</i> 金星石 JH: ST: <i>pho-so shih</i> 婆娑石
23	azurite (pale blue)	M 115 RP 85, 86, 86a V 228	basic copper carbonate, $2CuCO_3 \cdot Cu(OH)_2$	armenius lapis, armenium, caeruleum, sapphirus	CN: SN: SY: KM: <i>pai chhing</i> 白青 CN: MI: <i>fu chhing</i> 膚青 SN: ST: <i>pien chhing</i> 扁青 SY: <i>pi shih</i> 畢石 mod: <i>lan thung kung</i> 藍銅礦
	balas ruby, <i>see</i> spinel				
24	basanite (P), (touchstone, cf. Vol. 3, pp. 672-3)	G 101 King (2)	velvet-black flinty jasper	basanites, coticula	old: mod: <i>shih chin shih</i> 試金石
25	beryl	C 149, 175	beryllium alumino-hexasilicate, $3BeO \cdot Al_2O_3 \cdot 6SiO_2$		old: <i>tshui shêng shih</i> 催生石 <i>huang ya hu</i> 黃鴉琥 mod: <i>huang pao shih</i> 黃寶石
26	bezoar	RP 112 S 281 Wootton (1), vol. 2, p. 15	intestinal concretion of lime, cholesterol, bile acids and pigments, hair, etc., esteemed as universal antidotes both in East and West		PP: (perhaps confused with nodular iron pyrites) <i>shê huang</i> 蛇黃 ST: <i>niu huang</i> 牛黃
	biotite, <i>see</i> mica				

27	bitumen, <i>see</i> pitch black-jack, <i>see</i> zinc sulphide bole, <i>see</i> clay, red	Forbes (4, 10) RP 69	petroleum hydrocarbon fractions of high boiling-point	bitumen (the term included liquid petroleum, tars, pitches and asphalt hydrocarbon mixtures)	KM: <i>shih chhi</i> 石漆
28	borax (tincal) (P?)	G 139 L 503 M 141 RP 127 V 246	sodium borate, $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	chrysocolla (A)	JH: mod: <i>phêng sha</i> 硼砂 TF: <i>chen sha</i> 針砂 <i>ta phêng sha</i> 大硼砂 KM: ST: <i>phêng sha</i> 蓬砂 KM: <i>phên sha</i> 盆砂
29	brass (P)	C 325, 334 L 513 M 42 RP 17, 59 S 290	Cu/Zn alloy compositions (<i>see</i> pp. 195 ff.)	aes candidum, oreichalcos, aurichalcum, orichalcum	old: <i>huang yin</i> 黃銀 and other terms PP: <i>huang thung</i> 黃銅 SY: KM: ST: <i>thou shih</i> 鎗石
30	bronze (P) calamine, <i>see</i> zinc carbonate calcite, <i>see</i> calcium carbonate, stalactite, and stalagmite	C 329, 334 RP 6	Cu/Sn alloy compositions (<i>see</i> pp. 197 ff.)	aes, chalcos	generally: <i>thung</i> 銅 <i>chhing thung</i> 青銅 SHC: <i>chhih hsi</i> (?) 赤錫
31	calcium carbonate (P), (chalk, calcite, calcspar)	A 7, 53 M 83 RP 54, 119	CaCO_3	creta, argentaria creta	MI: SY: KM: ST: <i>fang chieh shih</i> 方解石 PP: <i>han shui shih</i> 寒水石 PP: mod: <i>ning shui shih</i> 凝水石
32	calcium hydroxide (slaked lime)	RP 70a, 71 S 286	Ca(OH)_2		gen: <i>shu shih hui</i> 熟石灰 <i>hsiao shih hui</i> 消石灰 if air-slaked: <i>fêng hua hui</i> 風化灰 (lime-water) PP: <i>hui chih</i> 灰汁
33	calcium oxide (P), (quicklime)	M 99 RP 71 S 286 V 218	CaO	assius lapis, sarcophagus lapis, saxum album, calx, titanos	SN: KM: ST: <i>shih hui</i> 石灰 (from mollusc shells): PP: SY: <i>mu li</i> 牡蠣 <i>pang kho</i> 蚌殼 <i>pang hsieh</i> 蚌屑 <i>pang fên</i> 蚌粉 SY: <i>shih yün tshu</i> 石雲慈 ST: <i>jan shih</i> 燃石 (also flint and coal) mod: <i>shêng shih hui</i> 生石灰

* This term was later adopted for preparations of steroid sex hormones; cf. Vol 5, pt. 5.

Table 95 (continued)

34	calcium sulphate (P), (gypsum, alabaster, plaster-of-Paris, the hemihydrate; <i>see also</i> selenite)	A 11, 56 C 224, 234 M 81 RP 51, 52 V 205	$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ hemihydrate, $2\text{CaSO}_4 \cdot \text{H}_2\text{O}$ anhydrite, CaSO_4	gypsum, specularis lapis	SN: SY: <i>li shih</i> 理石 SN: <i>han shui shih</i> 寒水石 <i>yü shui shih</i> 玉水石 PP: <i>lung shih kao</i> 龍石膏 MI: (<i>pai</i>) <i>chi shih</i> (白) 肌石 SY: <i>chien ching</i> 監精 KM: ST: mod: <i>shih kao</i> 石膏
	calomel, <i>see</i> mercurous chloride				
	carbon, <i>see</i> diamond, graphite, charcoal, coal, lamp-black		C, elementary	atramentum (?)	
	cassiterite (tin sand), <i>see</i> stannic oxide				
	cat's eye, <i>see</i> chrysoberyl				
	ceruse, <i>see</i> lead carbon- ate, basic				
	cerussite, <i>see</i> lead carbonate				
	chalcantite, <i>see</i> copper sulphate				
35	chalcedony	G 90 RP 30	micro-crystalline quartz (SiO_2)		PP: <i>yü chih</i> 玉脂 MI: KM: <i>pai yü sui</i> 白玉髓 SY: <i>hsüan chen chhih yü</i> 玄眞赤玉
	chalcocite, <i>see</i> copper sulphide				
	chalcopyrite, <i>see</i> copper iron sulphide				
	chalk, <i>see</i> calcium carbonate				
36	charcoal				gen: <i>than</i> 炭
37	chlorophane (cf. Vol. 1, p. 199)		a variety of fluorspar (CaF_2)		old: <i>yeh kuang pi</i> 夜光璽
38	chrysoberyl (cat's eye; cymophane)	C 105, 150 RP 35f	$\text{BeO} \cdot \text{Al}_2\text{O}_3$		old: <i>mao ching</i> 貓睛 KM: <i>mao ching shih</i> 貓睛石 mod: <i>mao erh yen</i> 貓兒眼
	chrysotile, <i>see</i> asbestos				
	cimolite, <i>see</i> aluminium silicate				
	cinnabar, <i>see</i> mercuric sulphide				
	clay, <i>see</i> aluminium silicate				

39	clay, blue clay, China (kaolinite), see kaolin	RP 57a	hydrated aluminium silicate	terra saxoniae	SY: KM: <i>chhing shih chih</i> 青石脂
40	clay, red siliceous (P), (red bole, sometimes perhaps laterite)	A 21 C 169 M 86 MK 81-3, 134-8 RP 57e V 208 S 274	hydrated aluminium silicate coloured by metallic salts (Fe, Mn)		SHC: <i>shih nieh</i> 石泥 CN: SN: PP: KM: ST: <i>chhih shih chih</i> 赤石脂
41	coal	C 201 G 71 M 97 RP 70 V 217	fossil carbon of plant origin		Han onwards: <i>shih than</i> 石炭 KM: ST: <i>shih than, mei than</i> 煤炭, <i>jan shih</i> 燃石, <i>shih mo</i> 石墨 mod: <i>mei</i> 煤
42	cobalt oxide	M 115 RP 85	CoO, from smaltite (CoAs ₂) or cobaltite (CoAsS)	cobathia (?)	KM: ST: <i>pien chhing</i> 扁青 ST: <i>hui-hui chhing</i> 回回青
43	cobalt speiss (smaltite)		CoAs ₂		ST: <i>chha wan yao</i> 茶碗藥
44	cobaltite (zaffer)	M 149	CoAsS	cadmia metallica (A), cobaltum ferri colore (A)	<i>yen shou</i> 岩手 <i>pao yeh shou</i> 保夜手
45	copper (P)	M 21 RP 6 S 291, 288 V 159	Cu metal	aes, chalcos, aes purum fossile (A)	TT: KM: mod: <i>thung</i> 銅 TP: KM: <i>chhih thung</i> 赤銅 (refined) SY: <i>shu thung</i> 熟銅
46	copper/lead alloys	M 43	Cu/Pb		ST (Jap): <i>thang chin</i> 唐金
47	copper/lead/tin alloys	M 43	Cu/Pb/Sn		ST (Jap): <i>huang thang chin</i> 黃唐金
48	copper/lead/tin/zinc alloys	M 43	Cu/Pb/Sn/Zn	claudianum	
49	copper/tin alloys, see bronze				
50	copper/zinc alloys, see brass				
51	copper/zinc/nickel alloys (paktong, cupro- nickel, cf. pp. 225 ff.)	S 284	Cu/Zn/Ni		ST: <i>pai thung</i> 白銅
52	copper acetate, basic (P), (verdigris, zingar)	L 510 M 26, 134 MK 193 RP 9, 121 S 291, 286, 293 V 162	2Cu ₃ (OH) ₂ (CH ₃ .COO) ₄	aerugo, rubigo, viride aeris	CY: KM: ST: <i>thung chhing</i> 銅青 ST: <i>lü yen</i> 綠鹽 <i>yen lü</i> 鹽綠

Table 95 (continued)

53	copper carbonate, basic (verditer, <i>see also</i> malachite, azurite)	C 152, 346 M 112 MK 184-5 RP 32, 82, 83, 84, S 281, 290, 287 V 225	$\text{CuCO}_3 \cdot \text{Cu(OH)}_2$	aerugo, chrysocolla, molochites (A)	(nodular) CN: SN: PP: SY: TF: KM: ST: <i>khung chhing</i> 空青 (laminar) CN: SN: PP: SY: TF: KM: ST: <i>tshêng chhing</i> 曾青 SN: SY: <i>lû chhing</i> 綠青 <i>chhing lang-kan</i> 青琅玕 SY: <i>chhih lung chhiao</i> 赤龍翹 <i>chhing lung hsüeh</i> 青龍血 KM: <i>thung lû</i> 銅綠 <i>shih lû</i> 石綠 mod: <i>khung chhiao shih</i> 孔雀石
	copper glance, <i>see</i> cop- per sulphide				
54	copper iron sulphide (copper pyrites, chalcopyrite)	RP 7, 8	CuFeS_2	chalcitis sory, misy, melaneria, pyrites aurei colore (A)	KM: <i>tzu-jan thung</i> 自然銅 mod: <i>thung kung shih</i> 銅鑛石
55	copper oxide (mixtures)	RP 6a	CuO , Cu_2O	aeris flos, aes ustum, scoria, lepis, squama, aes nigrum (A)	TF: <i>thung fên</i> 銅粉
	copper pyrites, <i>see</i> cop- per iron sulphide				
56	copper sulphate (P), (blue vitriol, chalcant- hite)	M 116 MK 190 RP 87, 132 S 287 V 229	$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	chalcanthron	CN: SN: PP: SY: KM: <i>shih tan</i> 石膽 TT: <i>chhiang shih tan</i> 羌石膽 TF: <i>tan tzu fan</i> 膽子礬 ST: mod: <i>tan fan</i> 礬礬
57	copper sulphide (copper glance or chalcocite) copperas, <i>see</i> ferrous sulphate	RP 7	Cu_2S	chalcitis, sory, misy, melaneria	KM: <i>tzu-jan thung</i> 自然銅 <i>thung kung shih</i> 銅鑛石
58	coral corrosive sublimate, <i>see</i> mercuric chloride	M 54 RP 33	concretions of coelenterates (calcium carbonate)		TP: KM: ST: <i>shan-hu</i> 珊瑚
59	corundum cuprite, <i>see</i> cuprous oxide cupro-nickel, <i>see</i> copper/ zinc/nickel alloys	C 128, 177 Hansford (1) M 126 RP 99 V 235	crystalline aluminium oxide (Al_2O_3), with iron oxides	naxium, smiris (A)	old: <i>chieh yü sha</i> 解玉砂 ST: <i>chih lí</i> 砥礪 mod: <i>pao sha</i> 寶砂, <i>hei sha</i> 黑砂
60	cuprous oxide (cuprite) cymophane, <i>see</i> chrysoberyl	RP 6a, 121	Cu_2O	flos aeris, (impure) squama aeris	KM: <i>thung lo</i> 銅落

61 diamond	C 90, 149 G 68 Hansford (1) Laufer (12) M 124 RP 99 V 167	crystalline C	adamas	HY: KM: ST: mod: <i>chin kang shih</i> 金剛石
62 dolomite	RP 96	double carbonate of magnesium and calcium, $MgCO_3 \cdot CaCO_3$		CY: KM: <i>hua ju shih</i> 花乳石 ST: <i>hua jui shih</i> 花蕊石 mod: <i>pai yün shih</i> 白雲石 CN and all subsequent: <i>lung ku</i> 龍骨
63 dragon bones	A 13, 14, 15, 16 Read (4)	fossil bones and teeth of extinct reptiles and mammals, furnishing Ca and P		
64 dragon's blood	Burkill (1), vol. 1, p. 857 R 717	red resin from trees of the <i>Dracaena</i> family	cinnabaris, sanies draconis	KM: <i>chhi-lin chieh</i> 麒麟竭
65 earthworm excreta	S 275	a very fine earth used as a component of sealing lutes		<i>chhiu-yin fén</i> 蚯蚓糞
electrum, see gold/silver alloys				
66 emerald	C 151 RP 35b	beryllium alumino-hexasilicate, $3BeO \cdot Al_2O_3 \cdot 6SiO_2$		old: <i>tsu mu lü</i> 祖母綠 mod: <i>lú pao shih</i> 綠寶石 <i>yao yü</i> 瑤玉
emery, see corundum		an intimate mixture of corundum and magnetite		
Epsom salt, see magnesium sulphate				
67 felspar	RP 53	polysilicates of aluminium and metal, e.g. $K_2O \cdot Al_2O_3 \cdot 4SiO_2$; $CaO \cdot Al_2O_3 \cdot 2SiO_2$	silex, ex eo ictu ferri facile ignis elicitur (A)	SN: SY: KM: mod: <i>chhang shih</i> 長石, <i>chhang ching shih</i> 長晶石
68 ferric oxide (haematite)	C 268 M 109 RP 78-81 V 223 Neogi & Adhikari (1)	Fe_2O_3	haematites, androdamas, hepatites, terra usta, minium, schistus	CN: SN: ST: <i>yü yü liang</i> 禹餘糧 CN: SHC: KM: <i>shih ché</i> 石碇 SY: <i>hsüeh shih</i> 血師 PP: <i>chhih shih</i> 赤石 (conglomerated brown haematite) PP: TP: KM: <i>shih chung huang</i> 石中黃子 SN: PP: SY: KM: ST: <i>tai ché shih</i> 代碇石 PP: SY: KM: <i>thai i yü yü liang</i> 太一禹餘糧 (if made by roasting ferrous sulphate, melanterite): <i>chiang fan</i> 絳礬 mod: <i>chhih</i> (or <i>ché</i>) <i>thieh kung</i> 赤(碇)鐵礦, <i>hsüeh shih</i> 血石 formerly shared many terms with haematite mod: <i>tsung thieh kung</i> 櫻鐵礦
69 ferric oxide (limonite)	A 12 RP 79	$2Fe_2O_3 \cdot 3H_2O$	schiston, ochra	

Table 95 (continued)

70 ferric oxide (rust)	M40 RP25 V172	Fe_2O_3 , hydrated	robigo, squama ferri, scoria sideritis	SI: KM: <i>thieh hsiu</i> 鐵鏽 (or <i>hsiu</i> 鏽), <i>thieh i</i> 鐵衣 ST: <i>thieh fên</i> 鐵粉
71 ferric sulphate	RP133	$\text{Fe}_2(\text{SO}_4)_3$ usually mixed with ferrous sulphate		SY: <i>huang lao</i> 黃老 KM: <i>huang fan</i> 黃礬 ST: <i>hei fan</i> 黑礬
72 ferric sulphide (iron pyrites, marcasite)	M25 MK183, RP7, 98, 112 S274 V161	FeS_2	chalcitis, sory, misy, melan- teria, (if arsenical) androdamas	MI: KM: SY: <i>chin ya shih</i> 金牙石 SY: <i>hu tho yu</i> 虎脫幽 KP: KM: ST: <i>tsu-jan thung</i> 自然銅 mod: <i>thieh liu</i> 鐵硫
73 ferrosferric oxide (see also magnetite)	RP22	Fe_3O_4	diphryges, faex aeris	SN: KM: ST: <i>thieh lo</i> 鐵落 mod: <i>thieh ho hsiu</i> 鐵合銹
74 ferrous acetate	RP24	$(\text{CH}_3\text{COO})_2\text{Fe}$		SN: <i>thieh ching</i> (?) 鐵精 KP: KM: <i>thieh hua fên</i> 鐵華粉
75 ferrous-aluminium sulphate (halotrichite)	RP133 S279	yellow iron alum, $\text{FeSO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 22\text{H}_2\text{O}$		gen: <i>huang fan</i> 黃礬
76 ferrous oxide	RP23 Neogi & Adhi- kari (1)	FeO		SN: KM: <i>thieh ching</i> 鐵精
77 ferrous sulphate (P), (green vitriol, melan- terite, copperas, cf. Vol. 5, pt. 4). See also glockerite	M147, 149 RP132 S273, 276 V248	FeSO_4 $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	atramentum sutorium, alumen, chalcantum	SY: <i>chi-shih fan</i> (?) 難矢 (=屎) 礬 <i>hsüan wu ku</i> 玄武骨 JH: TF: KM: ST: <i>lû fan</i> 綠礬 (melanterite) TF: <i>huang fan</i> 黃礬, <i>ching fan</i> 青礬 KM: mod: <i>tsao fan</i> 皂礬
78 flint	C171 G98 RP70a	cryptocrystalline silica (SiO_2)	silex	anc.: <i>jan shih</i> 燃石 KM: <i>jan shih</i> 然石, <i>sui shih</i> 遂石 ST (Jap): <i>huo sui shih</i> 火燄石
79 fuller's earth	RP57b	yellowish hydrated aluminium silicate	sarda creta, terra sigillata	CN: <i>ching o</i> 青礬 KM: <i>huang shih chih</i> 黃石脂 mod: <i>phiao pu chih ni</i> 漂布之泥 <i>phiao pai thu</i> 漂白土
galena, see lead sulphide				
80 garnet	C49, 55, 271 RP35g	orthosilicates of Al, Cr, or Fe^{+++} + Mg, Ca, Mn, or Fe^{++} e.g. $\text{Fe}_2\text{Al}_2(\text{SiO}_4)_2$		SW: <i>mei kuei</i> 玫瑰 KM: <i>shih liu tsu</i> 石榴子 mod: <i>shih liu tsu shih</i> 石榴子石 (crushed almandine) <i>hung sha</i> 紅砂, <i>tsu sha</i> 紫砂
81 geodes (P)	M95 RP79 V216	globular masses of haematite or other minerals containing loose nodules	aetites lapis (cf. Vol. 3, p. 652)	MI: PP: ST: <i>shih nao</i> 石腦 ST: <i>shih hsia ping</i> 石餉餅

82 glass (cf. Vol. 4, pt. 1, pp. 101 ff.)	RP 36	solid solution of Na and Ca silicates	vitrum (if blue) caeruleum	KM: ST: mod: <i>po-li</i> 玻璃
83 glass, volcanic (obsidian)	C 102 Laufer (13)	natural glass	obsius lapis	Han: <i>chhih yü</i> (?) 赤玉 Thang: <i>huo yü</i> (?) 火玉 <i>mê-hê</i> (?) 秣褐
Glauber's salt, <i>see</i> sodium sulphate				
84 glockerite	S 276	$2\text{Fe}_2\text{O}_3 \cdot \text{SO}_3 \cdot 6\text{H}_2\text{O}$		<i>hei fan</i> 黑礬
85 gold (P), (cf. pp. 193 ff., 257 ff., 273 ff.)	C 355 M 13 Pfizmaier (95) RP 1 S 274, 278 V 156	Au metal	aurum	CN and always subsequently: <i>chin</i> 金 (the metal <i>par excellence</i>) general usage and PP: <i>huang chin</i> 黃金 SY: <i>nan shih shang huo</i> 男石上火 (alluvial) TF: KM: ST: <i>fu chin</i> * 鉄金
86 gold/copper alloys (<i>see</i> Table 96)				
87 gold/lead/tin alloys	M 46	for gilding Cu (Au/Pb/Sn), <i>see</i> pp. 246 ff.		
88 gold/silver alloys (electrum)	M 46	Au/Ag, cf. pp. 36 ff.	asem, electrum	
89 grammatite	M 134	variety of asbestos or tremolite		ST: <i>hsüan ching shih</i> 玄精石
90 graphite	M 88 RP 57c	C, elementary		SY: KM: ST: <i>hei shih chih</i> 黑石脂 mod: <i>shih mo</i> 石墨
gypsum, <i>see</i> calcium sulphate, selenite, and spar				
haematite, <i>see</i> ferric oxide				
91 hair	Read (2) no. 409 S 283 Stapleton (1)	keratin		CN: (rabbit) <i>thu hao</i> 兔毫 late: (human) <i>luan fa</i> 亂髮
92 halloysite	A 43 S 278	hydrated aluminium silicate clay resembling kaolinite $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 4\text{H}_2\text{O}$		Thang: <i>hua shih</i> 滑石
93 horn, rhinoceros	A 2 Laufer (15) S 277	keratin		CN: PP: (and always later): <i>hsi chio</i> 犀角
94 iron	M 33 RP 20 V 169	Fe metal	ferrum	SN (and always later) <i>thieh</i> 鐵 (powder) <i>chen sha</i> 鐵(針)砂

* The term 'bran-flake gold' was an expressive one. My friend Mr John Wallace of Trinity College has successfully panned for gold at Suisgill Burn west of Helmsdale in Sutherland, and there one gets glittering flakes of native gold the size of small pinheads—though not very many.

Table 95 (continued)

95 iron/carbon alloys	M 37	Fe/C; wrought iron, cast iron, and steels. Cf. Needham (32), and (64), pp. 107 ff.		cast iron: <i>shêng thieh</i> 生鐵, <i>hsien</i> 鐵 steel: <i>kang</i> 鋼 (by direct decarburisation): <i>chen kang</i> 質鋼, <i>shun kang</i> 純鋼, <i>lien kang</i> 煉鋼 (by co-fusion): <i>su thieh</i> 宿鐵, <i>thiao thieh</i> 跳鐵, <i>kuan kang</i> 灌鋼, <i>thuan kang</i> 團鋼, <i>wei kang</i> 偽鋼 wrought iron: <i>shu thieh</i> 熟鐵, <i>jou</i> 錄, <i>hsieh</i> 錄
iron oxides, mixed, <i>see</i> ferric, ferrosferric and ferrous oxides				
iron pyrites, <i>see</i> ferric sulphide				
96 jade (jadeite)	C 125 Hansford (1) Laufer (8) RP 29-31	crypto-crystalline silicate of Na and Al; in pyroxene class. Cf. Vol. 3, pp. 663 ff.		Chhing: <i>fei-tshui</i> 翡翠
97 jade (nephrite, true jade)	C 111 Hansford (1) Laufer (8) M 52 MK 183 RP 29-31 S 294 V 176	crypto-crystalline silicate of Mg and Ca; in amphibole class and related to fibrous actinolite; coloured by Fe, Mn, Cr, Ti and V. Cf. Vol. 3, pp. 663 ff.		CN and always subsequently: <i>yü</i> 玉 <i>chen yü</i> 眞玉 (if powdered) <i>yü fên</i> 玉粉
jasper, <i>see</i> basanite				
98 jet	RP 29	black lignite (semi-coal)	gagates lapis	<i>hsi</i> 豎
kalinite, <i>see</i> alum				
99 kaolin (China clay, kaolinite)	C 193 M 87 RP 57d	alumino-disilicic acid $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$	terra sigillata (?), chia terra (?), samia terra (?), lemnia terra (?), medulla saxorum (A)	SY: KM: ST: <i>pai shih chih</i> 白石脂 SY: <i>pai su fei lung</i> 白素飛龍 mod: <i>kao-ling thu</i> 高嶺土 ST: <i>shih mien</i> 石麴
100 kieselguhr	M 101	siliceous diatom skeletons (SiO_2)		
kupfernickel, <i>see</i> nickel arsenide				
101 lapis lazuli (P), (ultra-marine)	C 1, 149 RP 38 Schmauderer (1, 2, 3)	mixture of (a) hauyne; silicate of Na and Al, with calcium sulphate, (b) lazurite; silicate of Na and Al, with sodium sulphide, (c) sodalite; silicate of Na and Al, with sodium chloride	sappheirus	KM: <i>liu-li</i> 琉璃 { a term originally used for coloured frits and enamels, as also opaque green glass mod: <i>chhing chin shih</i> 青金石

102 lamp-black (Chinese ink) laterite, <i>see</i> clay, red		conifer soot		<i>mo</i> 墨, <i>yen mei</i> 煙煤
103 lead (P)	M 26 RP 10 S 273 V 163	Pb metal	plumbum nigrum, galena	early: <i>hei hsi</i> 黑錫 CN: PP: SY: JH: KM: mod: <i>chhien, yuan</i> 鉛, 鉍 PP: <i>ho chhê</i> 河車 <i>ho shang yu nü</i> 河上遊女 SY: <i>hei chin</i> 黑金
104 lead/silver alloys		Pb/Ag; cf. pp. 36, 42-3, 278, 281	stannum, stagnum	
105 lead/tin alloys, <i>see</i> soldering metal, and pewter		Pb/Sn		
106 lead/tin/gold/copper alloys		Pb/Sn/Au/Cu; cf. pp. 20, 22, 195, 223	chrysocolla	ST (Jap): <i>chhih thung</i> 赤銅
107 lead/zinc mixtures (from mixed ores)		Pb and Zn (or true alloys with small amounts of Sn, cf. p. 211)		early: <i>yin</i> 鉛, <i>pai la</i> 白鐵, <i>pai hsi</i> 白錫, <i>la</i> 鐵, <i>hsi la</i> 錫鐵, <i>lien</i> 鏈, 鐵
108 lead acetate	M 28 RP 11 Schafer (9) V 165	(CH ₃ .COO) ₂ Pb	cerussa, psimithium	CN: <i>hei chhien tshu</i> 黑鉛醋 SY: <i>chin kung</i> 金公 JH: KM: <i>chhien shuang</i> 鉛霜 mod: <i>chhien thang</i> 鉛糖 ST: <i>pai fên</i> 白粉
109 lead carbonate (naturally occurring, cerussite)	Schafer (9)	PbCO ₃	plumbum nigrum lutei coloris (A)	
110 lead carbonate, basic (white lead, ceruse)	RP 12 S 278 Schafer (9)	2PbCO ₃ .Pb(OH) ₂	cerussa (?)	CN: <i>shui fên</i> 水粉 TT: PP: SY: <i>hu fên</i> 胡粉 originally 餹粉 SN: SY: <i>chieh hsi</i> 解錫 <i>chhien fên</i> 鉛粉 TF: <i>pai chhien</i> 白鉛 KM: <i>fên hsi</i> 粉錫, <i>shao fên</i> 韶粉 mod: <i>fên chhien</i> 粉鉛
111 lead monoxide (litharge, massicot)	M 29, 30 RP 14 Schafer (9) V 168	PbO	argyritis, chrysis, lauritis, molybdaena, molybditis, spo- dium, spuma argenti, usta	CN: <i>huang tan</i> 黃丹 TT: SY: <i>huang ya</i> 黃雅 or <i>ya</i> 牙 (for <i>ya</i> 芽) TT: <i>chin hua</i> 金華 PP: <i>tsu fên</i> 紫粉 TP: KM: mod: <i>mi-tho-sêng</i> 密陀僧 ST: <i>lu ti</i> 爐底
112 lead tetroxide (red lead, minium)	A 58 RP 13 S 279, 273 Schafer (9)	Pb ₃ O ₄ . Thang specimens contain much admixture of massicot, and perhaps also lead sesquioxide, Pb ₂ O ₃	minium secundarium, syricum, phoeniceum	SN: PP: KM: <i>chhien tan</i> 鉛丹 SY: <i>chhien huang hua</i> 鉛黃華 PP: ST: <i>huang tan</i> 黃丹 <i>chang tan</i> 彰丹
113 lead sulphide (galena)	RP 10 Schafer (9)	PbS	galena, magnesia, plumbarius lapis (A)	TF: KM: <i>tshao chieh chhien</i> 草節鉛 mod: <i>fang chhien</i> 方鉛

Table 95 (continued)

113a lignite (<i>see also</i> jet) lime, <i>see</i> calcium oxide		brown coal, semi-coal		ST: <i>jan thu</i> (?) 燃土
114 limestone (P), <i>see also</i> marble	C 268 M 128 RP 62, 71 S 285 V 235	CaCO ₃	saxum calcis (A)	KM: <i>tuan shih</i> 鍛石 <i>mi li tzu</i> 密栗子 ST: (oolitic) <i>mai fan shih</i> 麥飯石 (fibro-lamellar) <i>shui chung pai shih</i> 水中白石
limonite, <i>see</i> ferric oxide litharge, <i>see</i> lead monoxide lodestone, <i>see</i> magnetite				
115 magnesium carbonate (magnesite)	RP 96	MgCO ₃ , from dolomite, q.v.	eretria terra	
116 magnesium sulphate (Epsom salt, cf. Vol. 5, pt. 4)	A 35 MK 39-46, 142-7, 188 S 277	MgSO ₄ ·7H ₂ O		<i>mang hsiao</i> 芒消 KM: <i>shui hsiao</i> 水消
117 magnetite (P), (lodestone; <i>see also</i> ferrous-ferric oxide; cf. Vol. 4, pt. 1, p. 234)	C 370 M 106 MK 186 RP 76, 77 S 292 V 220	magnetic Fe ₃ O ₄ (non-magnetic iron oxide ore is termed in KM and ST <i>hsüan shih</i> , which must originally have been a synonym of magnetic iron ore; and in SN and MI <i>chhu shih</i>)	magnesia, heraclion	SN: SY: KM: ST: <i>tzhu shih</i> 慈石 TT: PP: <i>tzhu shih</i> 礧石 SY: <i>hsüan shih</i> 玄石 SY: ST: <i>chhu shih</i> 處石 TF: <i>thieh tzhu shih</i> 鐵礧石
118 malachite (green), basic copper carbonate		CuCO ₃ ·Cu(OH) ₂		KM: <i>lū chhing</i> 綠青
119 manganese dioxide (pyrolusite)	C 384 M 90 RP 61 V 212	MnO ₂	magnesia nigra	KP: KM: ST: <i>wu ming i</i> 無名異 mod: <i>hei mēng</i> 黑錳
120 marble	C 160, 148, 152 RP 52, 58	CaCO ₃	marmor	SHC: <i>wēn shih</i> 文石 TP: KM: <i>thao hua shih</i> 桃花石 KM: <i>li shih</i> 理石 mod: <i>ta-li yen</i> 大理岩
marcasite, <i>see</i> ferric sulphide massicot, <i>see</i> lead monoxide melanterite, <i>see</i> ferrous sulphate				
121 mercuric chloride (corrosive sublimate)	M 74 RP 45 V 199	HgCl ₂		TF: <i>hsüeh fan</i> 雪礬 KM: <i>pai hsiang tan</i> 白降丹 mod: <i>hung fēn</i> 汞粉

122	mercuric sulphide (P), (cinnabar, vermillion)	M 20, 69, 76, 78 MK 192 RP 43, 47, 48 S 275, 280 V 158, 188, 201	HgS	minium, anthrax	(naturally occurring) SN: TT: PP: SY: KM: ST: mod: <i>tan sha</i> 丹砂 PP: <i>chu erh</i> 朱兒 SY: <i>hsien sha</i> 仙砂 <i>chen chu</i> 眞珠 SY: TF: mod: <i>chu sha</i> 朱砂 TP old term for purest: <i>kuang ming sha</i> 光明砂 ST: <i>chhen sha</i> 辰砂 SY: <i>hsüan huang hua</i> 玄黃花 mod: <i>shui-yin chu</i> 水銀珠 PP: <i>kên hsüeh</i> 艮雪 TCY: <i>liu kên hsüeh</i> 流艮雪 SY: { <i>shui-yin shuang</i> 水銀霜 <i>chin i</i> 金液 <i>chhü ti thi hsüeh</i> 赤帝體 CY: KM: <i>shui-yin fên</i> 水銀粉, <i>chhing fên</i> 輕粉, <i>ni fên</i> 膩粉 KM: ST: <i>fên shuang</i> 粉霜 (when purified) mod: { <i>fei hsüeh tan</i> 飛雪丹 <i>kan hung</i> 甘汞 CL: KM: ST: <i>ling sha</i> 靈砂
123	mercurous chloride (calomel)	M 74, 76 MK 102 RP 45, 46 S 288-9, 282 V 199, 200	Hg ₂ Cl ₂		
124	mercurous sulphide	RP 48	Hg ₂ S (but HgS may also be black under some conditions, or greenish, as metacinnabarite)	aethiops mineral	
125	mercury (P), (quick- silver)	M 72 RP 5, 44 S 279, 288 V 197	Hg	hydrargyrum, argentum vivum	SN: SY: TF: KM: ST: <i>shui-yin</i> 水銀 TT: PP: <i>chha nü</i> 姹女 or <i>ho shang</i> <i>chha nü</i> 河上姹女 PP: <i>ling-yang tzu ming</i> 陵陽子明 <i>liu chu</i> 流珠 TT: PP: SY: ST: <i>hung</i> 汞 SY: <i>hsüan nü</i> 玄女 KM: <i>chu sha yin</i> 硃砂銀 mod: <i>hung</i> 錄 KM: <i>phi li chen</i> 霹靂磤 <i>lei mo</i> 雷墨
126	meteorites	G 115 ff. RP 113, 114	silicates or mixtures of metallic Fe and Ni. Often confused with pre- historic stone tools (cf. Needham, 56)		
127	mica	A 37, 52 M 64, 120 MK 147-50, 181 RP 29, 95 S 294 Schafer (5) V 187, 232	hydrated silicates of Al, Cr or Fe''' + Mg, Ca, Mn or Fe'' + Na or K; e.g. muscovite, H ₂ KAl ₃ (SiO ₄) ₃	specularis lapis, selenites, aphroselinon mica (A)	SN: TT: PP: SY: KM: mod: <i>yün</i> <i>mu</i> 雲母 anc: <i>huo chhi</i> 火齊 (biotite) ST: <i>chin hsing shih</i> 金星石

Table 95 (continued)

128	micaceous schist minium, <i>see</i> lead tetroxide mispickel, <i>see</i> arsenopyrite mosaic gold, <i>see</i> stannic sulphide muscovite, <i>see</i> mica	RP 95			CY: KM: <i>mêng shih</i> 礬石 ST: <i>chhng mêng shih</i> 青礬石
129	naphtha (P) nephrite, <i>see</i> jade	RP 69	petroleum light fractions of low boiling-point		Sung and KM: <i>mêng huo yu</i> 猛火油
129a	nickel arsenide (kupfer-nickel) niello, <i>see</i> silver sulphide obsidian, <i>see</i> glass, volcanic	RP 6	NiAs		<i>hung thung</i> 紅銅
130	ochre, red (P) ochre, yellow, <i>see</i> limonite		earth coloured by iron oxides hydrated ferric oxide	lemnia rubrica, lemmia terra, rubrica, sinopis melitinus lapis, ochra, sil	<i>chhih shih chih</i> 赤石脂
131	onyx	G 94 RP 34	microcrystalline silica, SiO ₂	onyx	mod: <i>kao ma-nao</i> 縞瑪瑙
132	opal orpiment, <i>see</i> arsenic trisulphide paktong, <i>see</i> copper/zinc/nickel alloys	C 150 G 102	microcrystalline silica, SiO ₂	opalus, opallios (cf. Lenz (1), pp. 166-7)	old: <i>wu phu erh lan</i> 屋模爾藍 mod: <i>pai pao shih</i> 白寶石
133	peach kernels	A 3 S 290	source of cyanide (<i>Prunus persica</i> , R448)		<i>thao jen</i> 桃仁
134	pearl (P)		CaCO ₃ concretion formed within the shells of oysters and other lamellibranch molluscs		PP and always subsequently: <i>ming chu</i> 明珠
135	petroleum (P)	C 205 M 96 RP 67, 69	all natural mixtures of aliphatic and aromatic hydrocarbons		PWC: MC: <i>shih chhi</i> 石漆 PP: MI: <i>shih nao</i> 石腦 CY: KM: <i>shih nao yu</i> 石腦油 ST: mod: <i>shih yu</i> 石油
136	pewter (lead/tin alloy) pickeringite, <i>see</i> alum pine-resin, <i>see</i> resin	S 281	Pb/Sn; cf. pp. 217ff.		late: <i>la</i> 鐵

137	pitch		highest boiling-point hydro-carbon fractions (above 300 °C) produced in the dry distillation of wood; later, the residue in the still after coal-tar distillation	pix, pissasphaltum (if mixed with asphalt); cf. Forbes (4a, b; 10)	li chhing 瀝青 (tar) chiao yu 焦油
	plaster-of-Paris, <i>see</i> calcium sulphate				
	polyhalite, <i>see</i> Abraum salt				
138	porphyry	RP 103	igneous rock in which one or more of the mineral species exist as well-formed crystals		TC: KM: mai fan shih 麥飯石
139	potash	S 279	potassium carbonate, K ₂ CO ₃ with a little sodium carbonate Na ₂ CO ₃ (product of lixiviation of wood ashes), giving potassium hydroxide, KOH, on treatment with lime. Used as detergent. <i>Hui chih</i> , however, may also mean calcium hydroxide	lixivium	TCY: hui chih 灰汁 sang hui chih 桑灰汁
	potash alum, <i>see</i> alum				
140	potassium nitrate (salt-petre, cf. Vol. 5, pt. 4)	C 241 M 135, 138 RP 125 V 244	KNO ₃ , naturally occurring as an efflorescence	spuma nitri (?) sal nitri	CN: SN: PP: SY: KM: hsiao shih 消石, 硝石 WT: ST: yen hsiao 焰消 MI: ti shuang 地霜 pei ti hsüan chu 北帝玄珠 SY: chih shih i 制石液 ho tung yeh 河東野 KM: khu hsiao 苦消 huo hsiao 火消 PP: hua chin shih 化金石 (or chin hua shih) ST: phu hsiao 朴消 mod: hsiao shih 硝石 SHC: chhih yin 赤銀
141	proustite (ruby silver ore)	C 323	Ag ₃ AsS ₃	argentum rude rubrum translucidum (A)	PP: JH: KM: fou shih 浮石 mod: chhing shih 輕石
142	pumice stone	M 102 RP 73 V 219	porous lava		SHC: chhih yin (?) 赤銀
143	pyrargyrite, <i>see also</i> antimony ore (ruby silver ore)	C 323	Ag ₃ SbS ₃	argentum rude rubrum (A)	
	pyrites, <i>see</i> copper sulphide, ferric sulphide				
	pyrolusite, <i>see</i> manganese dioxide				
	pyrophyllite, <i>see</i> agalmatolite				

Table 95 (continued)

144	quartz (various forms)	A 42 C 47 G 74 ff. M 66 MK 158-9 RP 40 S 284	crystalline silica, SiO ₂		SHC: <i>shui pi</i> 水碧 SN: SY: KM: ST: mod: <i>pai shih ying</i> 白石英 SY: <i>kung chung yü nü</i> 宮中玉女
	quicklime, <i>see</i> calcium oxide				
	quicksilver, <i>see</i> mercury				
145	raspberry, wild (unripe)		source of cyanide (<i>Rubus coreanus</i> , R 457, or <i>R. chingii</i>)		<i>fu phen tsu</i> 覆盆子
	realgar, <i>see</i> arsenic disulphide				
	red bole, <i>see</i> clay, red				
	red haematite, <i>see</i> ferric oxide				
	red lead, <i>see</i> lead tetroxide				
146	resin (pine, etc.)	B II, 225, 505 B III, 300, 301	polysaccharides, abietic acid, etc.		CN: <i>sung chih</i> 松脂 PP: <i>sung po chih</i> 松柏脂
147	resin (tacamahac)	A 36, 50 S 278	from <i>Populus balsamifera</i> (R 622), used as flux		<i>hu-thung lei</i> 胡桐淚
	rhinoceros, <i>see</i> horn				
148	rock crystal (transparent quartz)	A 42 C 40, 149 G 74 M 59 RP 37 S 288	crystalline silica, SiO ₂	crystallus	SHC: <i>shui yü</i> 水玉 SY: <i>ming ho ching</i> 明合景 SI: SY: KM: ST: <i>shui ching</i> 水精 Sung & mod: <i>shui ching</i> 水晶
149	ruby (<i>see also</i> spinel)	C 26, 63, 149 G 80 Laufer (13) RP 35a	crystalline alumina (Al ₂ O ₃) coloured by traces of metallic oxides		SHC: <i>lang-kan</i> (?) 琅玕 KM: <i>tsu tsu</i> 刺子 mod: <i>hung pao shih</i> 紅寶石 <i>chih shih ying</i> 赤石英
	ruby silver ore, <i>see</i> proustite, and pyrrhotite				
	rust, <i>see</i> ferric oxide				
	sal ammoniac, <i>see</i> ammonium chloride				
	saltpetre, <i>see</i> potassium nitrate				
150	sand (P)	G 89 M 130 RP 105	silica, comminuted quartz	arena	SI: KM: <i>ho sha</i> 河砂 TF: <i>hai pai sha</i> 海白砂 mod: (quartz) <i>huang sha</i> 黃砂

151 sapphire	C 63, 149 RP 35 b, e	crystalline alumina, Al_2O_3 , coloured by traces of metallic oxides	hyacinthus, sapphirus	old: <i>sê-sê</i> (?) 瑟瑟 KM: <i>tien tzu</i> 靛子 <i>ya hu shih</i> 鴉鵲石 mod: <i>lan pao shih</i> 藍寶石
152 selenite	MK 23-5 RP 120 S 289	variety of calcium sulphate, q.v., $CaSO_4 \cdot 2H_2O$, monoclinic		KP: KM: <i>hsüan ching shih</i> 玄精石 SY: <i>thai yin hsüan ching</i> 太陰玄精
153 serpentine	M 91 RP 31, 135 f	hydrated magnesium silicate, $H_4Mg_3Si_2O_{10}$	ophites	MI: KM: <i>pai shih hua</i> 白石華 ST: <i>shê chih</i> 蛇枝 mod: <i>lang-ying</i> 琅瑛
silicon dioxide, <i>see</i> quartz, rock crystal, sand, etc.				
154 silver	A 59 M 18 RP 2 S 293 V 157	Ag metal	argentum (also applied to argentiferous lead)	CN and always subsequently: <i>yin</i> 銀, <i>pai yin</i> 白銀 SY: <i>nü shih hsia shui</i> 女石下水 (naturally occurring): <i>shêng yin</i> 生銀
silver/lead alloys, <i>see</i> lead/silver				
155 silver amalgam	RP 4	Ag/Hg		TP: KM: <i>yin kao</i> 銀膏 TF: <i>shui-yin yin</i> 水銀銀 late: <i>yin ni</i> 銀泥
156 silver sulphide (silver glance, argentite, niello)		Ag_2S	argentum rude plumbei coloris (A)	ST: <i>wu yin</i> 烏銀
slaked lime, <i>see</i> calcium hydroxide				
smaltite, <i>see</i> cobalt speiss				
smithsonite, <i>see</i> zinc carbonate				
soapstone, <i>see</i> steatite				
157 sodium carbonate (trona, cf. Vol. 5, pt. 4)	RP 134	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$ natur- ally occurring as an efflorescence	nitron, nitrum	KM: mod: <i>shih chien</i> 石鹼 <i>chien</i> 鹼
158 sodium chloride (P)	A 38 C 180-1 MK 49-58, 151-5 RP 115-118 S 280, 289, 274, 284, 287 V 240	NaCl	sal (impure) sal hammoniacus	SN: PP: SY: (impure lake salt) <i>lu hsien</i> 鹵鹹 or <i>lu</i> 鹵 or <i>lu</i> 鹵 (and <i>hsien lu</i>) SN: PP: KM: <i>jung yen</i> 戎鹽 PP: <i>lu yen</i> 鹵鹽 MI: KM: <i>shih yen</i> 食鹽 (rock salt) TP: <i>kuang ming yen</i> 光明鹽 mod: <i>shih yen</i> 石鹽 <i>pai yen</i> 白鹽 PP: (if in large crystals): <i>ta yen</i> 大鹽, <i>yin yen</i> 印鹽 (if red, because of algal pigment or manganese oxides (wad) or chlor- ides): <i>chih yen</i> 赤鹽

Table 95 (continued)

159	sodium hydroxide		NaOH	aphronitrum (?) spuma nitri (?) (but in general no caustic alkalis were prepared till modern times, apart from the 'sharp waters' of Arabic alchemy; cf. Vol. 5, pt. 4)	
160	sodium nitrate (Chile saltpetre)		NaNO ₃		ST (Jap): <i>yen hsiao</i> 鹽消
161	sodium sulphate (Glauber's salt, mirabilite, cf. Vol. 5, pt. 4)	MK 40-3 RP 122-124 S 286	Na ₂ SO ₄ · 10 H ₂ O		SN: KM: <i>phu</i> (or <i>pho</i>) <i>hsiao</i> 朴消 <i>hsiao shih phu</i> (or <i>pho</i>) 消石朴 <i>yen hsiao</i> 鹽消 <i>phi hsiao</i> 皮消 SI: KM: <i>yen yao</i> 鹽藥 SY: <i>hai mo</i> 海沫, <i>shan tan</i> 單丹 (if purified) YH: KM: <i>hsüan ming fên</i> 玄明粉 ST: mod: <i>mang hsiao</i> 芒消 ST: <i>pai la</i> 白蠟 CN: PP: SY: KM: ST: <i>ning shui shih</i> 凝水石 PP: <i>ping shih</i> 冰石 mod: <i>han shui shih</i> 寒水石
162	solder (lead/tin alloy)	M 43	Pb/Sn	tertium	
163	spar	M 133 RP 119	gypsum; crystalline CaSO ₄		
	sphalerite, <i>see</i> zinc sulphide				
164	spinel (balas ruby)	Laufer (13)	double oxide of Mg and Al, with traces of Cr and Fe		old: <i>sê-sê</i> 瑟瑟
165	stalactite	A 22 C 213 M 92 RP 63-66, 68 V 214	calcite, calcium carbonate, CaCO ₃		CN: SN: SY: KM: ST: mod: <i>shih chung ju</i> 石鍾乳 SN: SY: KM: <i>khung kung nieh</i> 孔公孽
166	stalagmite	C 213 M 94 RP 63-66, 68 V 216	calcite, calcium carbonate, CaCO ₃		SN: ST: <i>yin nieh</i> 殷孽 TP: SY: <i>chiang shih</i> 薑石 ST: <i>shih chluang</i> 石牀 <i>ni shih</i> 逆石 <i>shih hua</i> 石花 PP: <i>shih kuei</i> 石桂
166a	stannic oxide (cassiterite)		SnO ₂ (rhombic or tetragonal crystals)		PP: <i>tou chin</i> 豆金
167	stannic sulphide (mosaic gold)	Wu & Davis (2), pp. 232, 264	SnS ₂		

168	steatite (soapstone, talc; <i>see also</i> halloysite)	A 43 C 157 M 84 RP 55 MK 85-8, 159-65 S 278 V 207	magnesium silicate, $3\text{MgO} \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$	lapis viridis, coupholith	CN: SN: PP: SY: KM: mod: <i>hua shih</i> 滑石 SHC: <i>lêng shih</i> 冷石 SY: <i>chün shih</i> 今石
	stibnite, <i>see</i> antimony sulphide				
169	sulphur (P) (natural, yellow)	M 143 MK 191 RP 128 S 287 V 246	S, elementary	sulphur	CN: PP: SY: <i>shih liu huang</i> 石流黃 SN: TT: PP: TF: KM: ST: <i>liu huang</i> 硫黃 SY: mod: <i>liu huang</i> 流黃 MI: KM: <i>shih liu chhing</i> 石流青
170	sulphur (amorphous, black; allotropic form)	RP 130	S, elementary		
171	sulphur (amorphous, red; allotropic form)	RP 129 S 287	S, elementary		MI: KM: <i>shih liu chhih</i> 石流赤
	tacamahac resin, <i>see</i> resin				
	talc, <i>see</i> steatite				
	tar, <i>see</i> pitch				
172	tin	M 31 RP 15 S 281 V 169	Sn metal	cassiteros, plumbum album; stagnum, stannum (but these more probably refer to alloys of Pb and Ag obtained in the smelting of Pb ores) plumbum candidum	SY: <i>khun-lun phi</i> 崑崙毗 SI: TF: KM: ST: mod: <i>hsi</i> 錫
	tin sand, <i>see</i> cassiterite				
	tincal, <i>see</i> borax				
173	topaz	C 152 RP 35c	aluminium fluoro-silicate	chrysolith	old: <i>chiu huang pao shih</i> 酒黃寶石 KM: <i>mu nan shih</i> 木難石 mod: <i>huang pao shih</i> 黃寶石
	touchstone, <i>see</i> basanite				
174	tourmaline	C 151	silicate of Al and B with varying amounts of other elements		mod: <i>pi hsi</i> 碧璽
175	tremolite	M 105 RP 75 V 220	variety of asbestos; Ca and Mg silicate		SN: KM: ST: mod: <i>yang chhi shih</i> 陽起石
	trona, <i>see</i> sodium carbonate				
176	turquoise	C 1, 149 Laufer (13)	hydrated aluminium phosphate $\text{Al}_2(\text{OH})_3\text{PO}_4 \cdot \text{H}_2\text{O}$		old: <i>tien tzu</i> 甸子 mod: <i>lü sung shih</i> 綠松石 <i>sung erh shih</i> 松兒石

Table 95 (continued)

ultramarine, <i>see</i> lapis lazuli verditer, <i>see</i> copper carbonate, basic verdigris, <i>see</i> copper acetate, basic vermilion, <i>see</i> cinnabar vinegar, <i>see</i> acetic acid vitriol, blue, <i>see</i> copper sulphate vitriol, green, <i>see</i> ferrous sulphate water, mineralised	G 19 M 54, 97 RP 20b (?) V 178	chalybeate, petrifying, containing H_2S , etc., from hot or cold springs		hsien wên chhüan 鹹溫泉 hsien lêng chhüan 鹹冷泉 (chalybeate deposit) ST: ti sou 地澆
white arsenic, <i>see</i> arsenolite white lead, <i>see</i> lead carbonate willemite, <i>see</i> zinc silicate		potassium hydrogen tartrate $(CH(OH).COO)_2KH$	tryginon, faex tartarum vini	chü shih 酒石
178 wine lees (argol, tartar)		Zn metal		+ 10th cent.: wo chhien 倭鉛 KM: pai chhien 白鉛 ST: ya chhien 亞鉛 mod: chêng 鉍, hsin 鉍
179 zaffer, <i>see</i> cobaltite zinc (cf. pp. 212 ff.)	M 41 RP 59			TF: hu nü sha 胡女砂 KM: ST: lu kan shih 爐甘石
zinc blende, <i>see</i> zinc sulphide				
180 zinc carbonate (smithsonite, zinc bloom, zinc spar, calamine)	RP 39, 59	$ZnCO_3$	cadmia (but the term covered all kinds of mixed sublimates in the flues of Cu and vAg smelting furnaces) cadmia, (pure) pompholyx, (impure) spodos, tutia, tutty cadmia galena inanis (A)	
181 zinc monoxide (P)	RP 59	ZnO		mod: chêng tien kung 鉍電鑛 mod: kuang chêng kung 光鉍鑛
182 zinc silicate (willemite)	RP 59	$2ZnO \cdot SiO_2$		
183 zinc sulphide (zinc blende, black-jack, sphalerite)	RP 59	ZnS		
zingar, <i>see</i> copper acetate, basic				

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(c) THE METALLURGICAL-CHEMICAL BACKGROUND;
IDENTIFICATIONS OF ALCHEMICAL PROCESSES

The pages in pt. 3 which form the main body of this Section will contain a mass of historical material on the development of laboratory alchemy and proto-chemistry throughout the Chinese centuries, and a great deal of this is concerned with aurification and aurifaction in various forms. Apart therefore from the salts and non-metallic compounds which are discussed in connection with elixirs (pt. 4), as also in the context of empirical industrial technology in Sect. 34, metallurgical chemistry takes a prominent place.^a If what we have assembled on the chemical proceedings in China from the —3rd century onwards is read over without an appropriate mental background, the records are liable to seem mysterious and baffling, ultimately even tedious, but if one is prepared beforehand with a little knowledge of what it is possible to do by the mixture of the older metals in a variety of alloys, one can interpret as one goes along, and form a succession of fairly probable guesses as to what the alchemists were really doing. In fact, the range of possible gold-like and silver-like alloys is very impressive, and so long as the particular princes or high officials concerned did not insist on handing over the products to the artisan-goldsmiths for testing by cupellation, a great deal of perfectly valid aurification and perfectly sincere aurifaction was possible. We shall try to avoid trespassing too much on the ground of the section devoted to non-ferrous metallurgy in general (Sect. 36), but some account of 'artificial' or 'imitation' golds and silvers is really indispensable at this point.^b It is a matter of reconstructing what the 'false gold' and the 'alchemical gold' of ancient and medieval China could have been.^c

The relevant information divides fairly naturally into several headings. First we have to think of alloys that are 'the same all through', whether dilutions of the precious metals in varying degree or imitations of their colour and lustre by the combination of others. Then it is possible to deposit the precious metals in layers of varying thickness on the body of a metal or an alloy not containing them, hence all the forms of gilding, but it is equally possible to abstract base metal from the surface layers of a mixture leaving only the gold or the silver.^d When the surface layer becomes microscopically thin one can begin to speak of a surface film, and finishes of this kind, brought about by chemical action on the exterior of a solidified alloy, can sometimes be very beautiful and quite permanent. Besides all these there are unique

^a For a comparative study of the metallurgical knowledge of the Hellenistic proto-chemists there is no better survey than that of Ruska (11).

^b It will be convenient for the reader if he can have recourse to some of the more old-fashioned treatises on non-ferrous metallurgy, especially those with a historical slant, such as the books of Wm. Gowland, J. Percy (1-4) and A. H. Hiorns.

^c In the ancient and medieval descriptions of various metals and alloys with which we shall be dealing the nomenclature is difficult because the old authors were neither precise nor consistent. The involved nature of some of the consequent argumentation is nowhere better seen than in the valuable book of Chang Hung-Chao (1), still not at all superseded. There are thus bound to be various uncertainties and discrepancies, as will be seen in some of our own examples in what follows.

^d Cf. p. 38 above.

phenomena to be considered. We can thus think in terms of a series of topics as follows:

- (a) uniform substrate alloys;
- (b) surface-layer enrichment by addition;
- (c) surface-layer enrichment by withdrawal;
- (d) surface-film formation;
- (e) special cases.

Having had a look at all the possibilities implicit in these, we can end by examining certain remarkable medieval Chinese lists of types of gold and silver, some considered 'false' and some 'true', and seeing how far we can identify the methods by which the former were produced. For the present purpose a fairly simple-minded treatment will suffice, leaving metallographic considerations, and such matters as the distinction between eutectic alloys and other phases, for a more technical and sophisticated place (Sect. 36).^a

(1) THE AVAILABILITY OF METALLIC ELEMENTS

First we must consider the alloys of uniform composition, but one point needs making at the outset, namely that from early times it was possible for the Chinese alchemist to use certain ores, and to incorporate in his products certain metallic elements, which were not so readily available in other parts of the Old World. For a variety of different reasons, several of the more unusual or lesser known metals cannot be ruled out. We must reckon therefore with the possibility (or even probability) that some of the aurifictive or aurifactive alloys discovered by the proto-chemists of medieval China contained one or more of these, a circumstance which lends particular interest to the percentage tables we shall discuss in what follows. About gold and silver themselves, copper and tin, constituents of age-old bronze, lead and iron in all its forms, nothing need here be said, because of their ubiquity common to all ancient civilisations, but zinc is another matter. From a date most probably as early as the very beginnings of Chinese alchemy in the -3rd (or even -4th) century, so we shall argue presently (p. 199), the discovery had been made that by adding zinc carbonate, calamine or smithsonite (*lu kan shih*)^b to molten copper, a new yellow metal, capable of resembling gold very closely to the eye, could be produced. Brass, however, had also been known in Hellenistic and Roman, if not Greek, antiquity, and made in the same way,^c so there was nothing unique in the Chinese alchemist having zinc at his disposition—not, at least, until some time in the +9th century, when, long before competitors in any other

^a So also the question of inter-metallic compounds, on which see Westbrook (1).

^b RP 59. One of the oldest sources of zinc in the West was the powder (zinc oxide, furnace calamine) scraped from furnace flues after the smelting of silver and other metals the ores of which contained a certain amount of zinc. This was Pliny's *cadmea fornacum* (*Nat. Hist.* xxxiv, xxii, 100ff.; Bailey (1), vol. 2, pp. 33 ff., 166 ff.), and the Chinese name 'sweet mineral from furnaces' shows that it was originally obtained in a closely similar way; only later was the appellation used for naturally occurring smithsonite.

^c Cf. p. 198 below.

¹ 爐甘石

culture, he succeeded in preparing systematically supplies of the isolated metal by a kind of distillation. Thenceforward the making of a great variety of brasses could be engaged in with much more precision.

The outstanding case of a metal which through many centuries the Chinese (in a sense) possessed while no one else did is nickel, and they were therefore far and away the earliest people to make cupro-nickel. Since we have been for years familiar with this as the 'silver' of our currency, one can see that there may have been something very real indeed about classical 'argentification' in China, and a new light is thrown upon My Lord of Verulam's remark quoted above (p. 33) about the Chinese being mad upon the making of silver. As we shall see, China exported to the West ingots and objects made of 'paktong' (*pai tung*,¹ white copper, or better, white bronze) from the +16th century onwards, and this was nothing else but cupro-nickel. How far its making went back in that civilisation we shall presently discuss; here it is necessary only to add that nickel arsenide ore (the deceptively named kupfernickel, *hung tung*² or niccolite)^a simply took the place of calamine, and paktong was made instead of brass. Neither alloy was allowed to contain much tin, which is injurious to the properties of both. Metallic nickel, however, unlike zinc, was never isolated in traditional China, but rather in Sweden in the +18th century. The related element cobalt is another metal which cannot be excluded from Chinese artificial alloys, especially after the beginning of the Ming, when indigenous supplies of some cobalt ore were discovered and used for colouring the famous blue-and-white porcelain; but even before that time it had been imported from Persia.^b

Next we must think of tungsten and the semi-metals (to use a convenient but obsolete term)^c antimony and bismuth. They raise the possibility that the alchemists may well have been capable of using minerals and ores which were never admitted to the pharmaceutical natural histories, and therefore never gained Chinese names easily accessible to us today. After all, if they had no clear medicinal value they had little right of entry, and besides they may have been known only locally by folk names which have disappeared or could now be recovered only with great difficulty. Furthermore the successful alchemists who used them would not have been at all desirous of their becoming more generally known. It is true that stibnite (antimony sulphide, Sb_2S_3), or a closely related silver-containing ore, answers to the name of *hsi lin chih*³ in the *Pên Tshao Kang Mu* and later natural histories from the end of the +16th century onwards,^d but so far as we know, no ore of tungsten or bismuth appears in that literature at any date. Yet this is passing strange when one remembers that in our own time

^a RP6.

^b See Young & Garner (1); Banks & Merrick (1). The provenance can be deduced from estimations of the amounts of adventitious manganese accompanying the cobalt.

^c Cf. A. Smith (1), pp. 119, 404, 537ff. They give both basic derivative compounds like metals and acidic ones like non-metals.

^d RP3. Many tomb objects of lead with an antimony content of 5% or more, dating from Shang and Chou times onwards, are known (Fig. 1322). It is unlikely however that the alloy was intentional, except in the sense that antimonial lead ores may have been specifically chosen, since antimony toughens lead. Cf. di Villa (1), pp. 71ff.; Torgashev (1), pp. 217ff.; Gowland (9), pp. 441.

¹ 白銅

² 紅銅

³ 錫悞脂

China has become the greatest world producer of antimony^a and tungsten,^b while bismuth occurs in association with wolframite in Kuangtung^c and in any case is recoverable from the smelting of copper and lead.^d One is therefore entitled to suspect that from time to time the alchemists did make use of minerals containing these metallic substances, and that when we find them in alloys known and habitually used today we should leave open the possibility that in medieval times compositions of similar properties were occasionally produced, though often no doubt the secret died when the adept himself did.

By contrast arsenic was an element in compounds among those most prominent on the shelves of the alchemical laboratories of ancient and early medieval China, and provided it could in some way be prevented from volatilising it could be introduced into any silver-like alloy that there was an intention to make, or of course used, as in the West, to whiten the surface-layers of compositions containing mostly copper. As realgar (arsenic disulphide, As_2S_2 , *hsiung huang*¹), orpiment (arsenic trisulphide, As_2S_3 , *tshu huang*²) and white arsenic (arsenious oxide, As_2O_3 , *yü shih*³ or *phi shih*⁴),^e it was universally available. Arsenic must assuredly have figured in many medieval Chinese alloys. Whether manganese got into any of them is not quite so certain, but the dioxide, natural pyrolusite, was described as *wu ming i*⁵ in the pharmaceutical natural histories, at least from +973 onwards, the time of appearance of the *Khai-Pao Pên Tshao*.^f The fact that early in the present century cast iron containing 20% of manganese was widely exported under the name of 'mirror iron', *ching tzu thieh*,⁶ may perhaps be an indication that pyrolusite or other natural manganese sources were in fact employed much earlier, and for alloys not principally ferrous in character.^g As for magnesium, dolomite, the mixed carbonate with calcium, was familiar in the *pên tshao* literature as *hua ju shih*,⁷ at least from +1060 onwards, the date of the *Chia-Yu Pên Tshao*, the oldest, so far as we know, to have an entry for it.^h Magnesite, the carbonate solely of the metal itself, also occurs in China, however,ⁱ and some of the alchemists may have made use of it, if they could have reduced it under their conditions. Besides this, there is evidence (cf. Vol. 5, pt. 4) that Epsom salt, magnesium sulphate, MgSO_4 , was produced systematically by fractional crystallisation in medieval China, so this also may have been submitted to the heat of the alchemical furnaces.

^a Cardew (1); Wei Chou-Yuan (1), pp. 444ff.; Bain (1), pp. 30, 150; Torgashev (1), pp. 217ff.; Tegengren (2); Wheler (1); and Wang Chhung-Yu (2, 3) in the best modern treatise on the technology of antimony production.

^b Cardew (1); Wei Chou-Yuan (1), pp. 436ff.; Bain (1), *loc. cit.*; Collins (1), p. 103; Torgashev (1), pp. 229ff. The best modern treatise on tungsten and its production has also been written by Chinese metallurgical chemists, Li Kuo-Chhin & Wang Chhung-Yu (1). I myself had the opportunity of visiting some of the wolframite and other mines of the National Resources Commission when in the provinces of Kuangsi, Hunan and Kuangtung during 1944.

^c Collins (1), *loc. cit.*; Torgashev (1), pp. 247ff.

^d Bain (1), p. 190.

^e RP 49, 50, 88 and 91 respectively.

^f RP 61.

^g RP 28. This *Spiegeleisen* made the Bessemer process practical, and played an important part in the development of modern metallurgy.

^h RP 96.

ⁱ Bain (1), p. 206; Torgashev (1), pp. 390ff.

¹ 雄黃

² 雌黃

³ 礬石

⁴ 砒石

⁵ 無名異

⁶ 鏡子鐵

⁷ 花乳石

Some metals, of course, such as platinum, palladium, and possibly cadmium, can be excluded from the medieval Chinese set of metals and minerals with a fair degree of certainty. But aluminium occupies a place by itself, and a somewhat controversial one, for during recent years it has been the centre of a kind of *cause célèbre*, by no means as yet resolved. In 1956 a team of archaeologists from the Nanking Museum, headed by Lo Tsung-Chen (1), excavated at I-hsing¹ in Chiang-su the tomb of a Chin dynasty worthy, Chou Chhu,² who died in +297.³ Some twenty metal belt-ornaments were found embedded in dust and dirt near the waist of the body, and many of the fragments of these were submitted to chemical analysis. Though some were mainly of silver and copper,^b others were almost wholly of aluminium, with up to 10% of copper and 5% of manganese. Since aluminium is a very difficult metal to smelt and was not isolated until after 1827, this discovery aroused intense interest in the realm of metallurgical-chemical history. The large-scale production of aluminium from bauxite by electrolysis was achieved only in 1889, so the discovery of an alloy dating from the +3rd century yet having aluminium as its main constituent remains quite extraordinary. Further confirmatory analyses were presented in 1959 by Yang Kên (1), who reported a laboratory experiment in which charcoal was used as the reducing agent, aluminium oxide powder and finely comminuted copper as the materials, with borax as a flux; on heating, a small amount of a low aluminium-copper alloy was produced. No metallurgical chemist is prepared to believe, however, that an 85% aluminium-copper alloy could ever be obtained by such methods, nor is there less scepticism about another proposed technique in which caustic alkali would release ionised metallic sodium or potassium to replace successive small quantities of aluminium which would then immediately dissolve in the molten copper.^c Yang Kên's communication gave rise to a considerable *retentissement* in Western technical journals,^d and chemists began to range themselves on opposite sides, in China as well as in Europe. While Chang Tzu-Kao accepted the findings whole-heartedly,^e they were strongly criticised by Shen Shih-Ying (1), who himself, however, found high aluminium contents in some of the material,^f mixed with minor constituents which would not be expected in modern aluminium produced by electrolysis—unless it had been re-melted in a not excessively clean workshop.^g What he threw doubt on was the exactness of the archaeological excavation, but this is just what is difficult to query for those who are aware of the high scientific standards achieved in such work under the auspices of Academia Sinica during the past two or three decades. The dig was defended in a rejoinder by Lo Tsung-Chen (2), but pending further developments some of the chemists are at

^a Chou Chhu was a military commander who died fighting the Tibetans, but also a scholar interested in ethnology and popular customs, on which he wrote a *Fêng Thu Chi*.³

^b With traces of gold, iron, lead, magnesium, calcium, bismuth and silicon.

^c Private communications from the late Prof. J. R. Partington and from Dr Cyril Stanley Smith.

^d Anon. (89, 90, 91).

^e (2), pp. 57ff.

^f He was the only investigator to do gravimetric rather than spectrographic estimations and he found not 85% Al but better than 95%.

^g Notably Fe 1%, Si up to 1%, Cu 0.2% and Mg 0.3%.

¹ 宜興

² 周處

³ 風土記

loggerheads with the archaeologists on the matter. For us the lesson seems to be that for the present it would be unwise to rule out the possibility that some medieval Chinese alchemical alloys may have contained aluminium.^a After all, the spagyric metallurgists were constantly mixing metals and minerals and heating them together, while temperatures sufficient to melt cast-iron had been available since the late Warring States period. The question also remains to be answered whether these aluminium-copper alloys, if genuine, were obtained intentionally or by accident due to the use of particular ores. The argument that the secret, if such it was, could hardly have been altogether lost in later periods, is rather a weak one, for as we shall have abundant opportunities of noting, the Chinese alchemists were disinclined to be talkative about their special triumphs, and in the secretive period of medieval science, processes could only too easily be lost with their authors. We shall see, therefore, whether any other ancient high-aluminium articles turn up, reserving judgment in the meantime. So much for the metals which the adepts of old could or could not have used.

(2) GOLDEN UNIFORM-SUBSTRATE ALLOYS

The door is now open for looking at a few alloy compositions. The most obvious way to imitate gold without using a lot of the precious metal was to dilute or 'debase' it with other metals, and this was always aided by the fact that gold keeps so much of its colour on dilution, though the tint changes very appreciably. In Table 96 a number of mixtures still employed today are set forth,^b from which one can see that quite a variety of 'golden' tints can easily be produced.^c Lists of such appearances from ancient texts have been preserved from Babylonia^d and from Ancient Egypt.^e Debasement of one kind or another is of course the simple explanation of the *diplōsis* so often referred to by the Alexandrian artisans and aurifactive philosophers, and several times mentioned already (pp. 18, 45).^f It must also be the meaning of the statement in the *Shen Nung Pên Tshao Ching* that copper sulphate (*shih tan*¹) can be used to 'prepare' gold and silver (*chhêng chin yin*²).^g

Table 96 contains mostly alloys that are still useful in the goldsmiths' trade today, but those which were made by the Hellenistic proto-chemists—and certainly by their colleagues in ancient China also—need not have been 'useful' in the modern commercial sense, where good malleability and ductility are required, as long as they looked

^a I recall being told by my friend Mr Rewi Alley in Peking in 1964 that on several previous occasions he had purged his own collection of ancient and medieval belt-buckles of specimens which looked and weighed much as aluminium would, on the assumption that it was impossible that they could be genuinely old.

^b Ref. Hiorns (2), pp. 139, 151, 361 ff., 372 ff., 453; Hiscox (1), pp. 50, 66, 68 ff., 73.

^c Cf. Forbes (3), p. 218.

^d Levey (2), p. 188.

^e Lucas (1), p. 266.

^f Cf. Berthelot (1), pp. 215 ff., (2), pp. 29 ff., 32, 38, 56 ff., 64 ff.; Leicester (1), p. 39; Partington (1), pp. 39 ff.; Sherwood Taylor (2), p. 129.

^g Cit. *CLPT*, ch. 3, (p. 89.2). Mori ed. ch. 1, (p. 24); Ku Kuan-Kuang ed. ch. 3, (p. 54). *TPYL* adds *ho*.³

¹ 石膽

² 成金銀

³ 合

Table 96. *Diluted or 'debased' golds (percentage compositions)*

	Au	Ag	Cu	Sn	Zn	Cd	Fe	Al	Pa	
'Dilutions'										
22-carat (coinage) gold	91.6	—	8.3	—	—	—	—	—	—	
hardened gold	91.6	—	—	—	8.3	—	—	—	—	must not go above 17% Zn
'green' gold	75	12	9	—	—	4	—	—	—	a form of <i>electrum</i> or <i>asem</i>
v. pale yellow gold	33	66	—	—	—	—	—	—	—	above 50% Ag tends to white
bright yellow gold	52	26	22	—	—	—	—	—	—	very like <i>Corp. Alchem. Gr.</i> 1, xix,
pale red gold	64	11	27	—	—	—	—	—	—	the <i>diplōsis</i> of Eugenius
bright red gold	50	—	50	—	—	—	—	—	—	
grey gold	80	10	—	—	—	—	10	—	—	
blue gold	75	—	—	—	—	—	25	—	—	
7-carat gold	29	33	38	—	—	—	—	—	—	lowest habitually used in jewellery
watch-bearings anti-friction metal	37.5	22.9	27.1	—	—	—	—	—	12.5	
Nuremberg gold	2.5	—	90	—	—	—	—	7.5	—	
scintillating purple gold	78	—	—	—	—	—	—	22	—	cf. p. 268
Japanese 'black gold'										
<i>shakudō</i>	1.5	1.2	94-98	—	—	—	—	—	—	cf. Table 100 and pp. 264-5; Gowland (6, 12)
Talmi or Abyssinian gold	0.5-1.5	—	85-94	1	6-12	—	—	—	—	essentially a gold-containing brass
Leiden papyrus X, no. 31, <i>chrysocola</i>	28.5	14.25	57.25	—	—	—	—	—	—	like gold solder; Caley (1)

attractive and were not too curiously enquired into by cupellation.^a Palladium and probably cadmium were of course impossible constituents for ancient and medieval workers at either end of the Old World, but aluminium is, as we have seen, just conceivable in China. Gold, silver and copper in many different proportions must have been the staple manufacture both in East and West, but it is clear from the texts that in the Hellenistic region, and doubtless in China also, other metals were frequently introduced, especially tin,^b lead,^c zinc,^d and arsenic.^e Sometimes these were all compacted first, as in the case of the whitish metal *claudianum*, so named from the emperor Claudius (r. +41 to +54) and consisting of a mixture of copper, tin, lead, zinc and arsenic,^f afterwards alloyed with small amounts of gold or silver.^g This was essentially a gold-containing brass, not unlike the Talmi or Abyssinian gold of more recent times, though also possessing a little lead and arsenic; the last would have increased the hardness and brittleness though perhaps its effect was cancelled out by the lead. The only other noteworthy composition in Table 96 is the Japanese alloy, for we shall meet with it again presently in connection with surface-films. The discovery here was that very small amounts of gold in an alloy give it the property of accepting certain remarkable colours when 'bronzed' in a dip (cf. p. 264 below), and it seems most probable that this kind of thing was first done in China, though, as so often, brought to perfection in Japan.

(i) *The origin of the brasses*

We are now free to examine the multifarious alloys which were capable of looking very like gold and silver without having any of the precious metals in their composition at all. Of these the most ubiquitous are the brasses and the bronzes, some varieties of which can resemble gold and silver quite closely in appearance (cf. Table 97).^h So much is this the case that varieties of brass containing from 10 to 35% Zn are, when comminuted to the form of very fine flakes, the principal constituents of gold paints at the present day.ⁱ The characteristic golden colour persists strongly up to some 40% Zn, after which the metal looks reddish, then white, especially if some nickel is added to make it a kind of cupro-nickel. Above 66% Zn the brittleness becomes too great to give the alloys much usefulness. Little tin is used in brasses as it spoils their working

^a Hatchett long ago (1) looked into the physical effects produced on gold by alloying with small amounts of other metals. Apart from Ag, Cu, Fe and Sn, brittleness and discoloration always resulted, from bad to worse in the order Ni, Mn, Co, Zn, As and Sb.

^b Berthelot (2), pp. 28 ff., 35 ff., 38, 45, 55, 62.

^c Berthelot (2), pp. 32, 45, 55, 61, 66.

^d Berthelot (2), pp. 32, 45, 46.

^e Berthelot (2), pp. 67 ff.

^f The exact composition is not now known.

^g Cf. Berthelot (2), pp. 67, 70, 71, elucidating recipes of Pseudo-Democritus (*Corp. Alchem. Gr.* II, i, 6, 7) and Olympiodorus (c. +500, *Corp.* II, iv, 12).

^h Ref. Hiorns (2), pp. 139, 150, 151, 153, 155, 237, 241, 246, 248, 250, 255, 274; Hiscox (1), pp. 51 ff., 53 ff., 56, 58, 63, 68 ff., 492; Partington (10), pp. 330, 386. Forbes (3), p. 272, (28), pp. 261, 265, does well to point out that brass (and later often spelter) was long spoken of in the West as *konterfei* or *countrefey* = counterfeit, i.e. 'mock gold'. Pettus (1) in +1683 says that copper with calamine makes brass, and (significantly) that 'tin and brass make alchymy'. 'Alchymy' in +1488 was arsenical copper.

ⁱ Collas (8) in Peking about +1785 tested some samples of Chinese gilded paper by burning, and showed that gold leaf had not been used. If it was not stannic sulphide (cf. p. 69 above and pt. 3 below) it was probably low-zinc brass powder applied with gum or a drying oil.

Table 97. *Brasses and bronzes (percentage compositions)*

	Cu	Sn	Zn	Pb	Fe	Al	Ni	P	colour and properties
Brasses									
gilding metal	92-97	—	3-8	—	—	—	—	—	suitable for gilding with gold amalgam
pinchbeck	88-93	—	7-12	—	—	—	—	—	dark golden ^a
similar or Mannheim gold or Prince's metal	84	7	9	—	—	—	—	—	imitation gold, a 'bronze'
chrysochalc	90.5	—	8	1.5	—	—	—	—	imitation gold
ormolu or oreide	80-90	0.5	10-16	—	0.25	—	—	—	imitation gold
tombac or Tournay's metal	82-90	—	10-18	—	—	—	—	—	golden
best brass (Bath metal, Dutch gold)	76-84	—	16-24	—	—	—	—	—	bright gold
cartridge brass	70	—	30	—	—	—	—	—	yellow
common brass	66	—	33	—	—	—	—	—	yellow ^b
casting brass	62-73	1-2	22-33	1-3	—	—	—	—	yellow
chrysin, Hamilton's metal	64.5	0.3	32.5	2.7	—	—	—	—	golden-yellow
Muntz metal	60-62	—	38-40	—	—	—	—	—	easily hot-rolled, corrosion-resistant, used for ships' sheathing
naval brass	62	1	37	—	—	—	—	—	golden-yellow, corrosion-resistant
Aich metal	60	—	38	—	0.7-2	—	—	—	golden-yellow, corrosion-resistant
Macht metal	57	—	43	—	—	—	—	—	reddish-yellow
sterro or Delta metal	55	—	41	—	2-4	—	—	—	strength equivalent to fine steel
high tensile brass	50	—	45	—	—	—	5	—	a paklong, cf. Table 101
nickel brass	45	—	45	—	—	—	10	—	white, a paklong, cf. Table 101
white brass	34	—	66	—	—	—	—	—	white, used for solder
Sorel's alloy	10	—	80	—	10	—	—	—	bluish-grey

Bronzes ^c									
modern coinage and medallion bronze	95-97	2-4	1	—	—	—	—	—	
gun metal	90-92	8-10	—	—	—	—	—	—	
machine bronze	80-90	5-18	—	1-9	—	—	—	—	
bearings bronze brass	80-90	4-22	2-15	—	—	—	—	—	gold-like
casting bronze									
antique	65-90	10-35	—	1-15	—	—	—	—	cf. the <i>Khao Kung Chi</i> figures in Sect. 36
modern	65-90	3-7	3-30	3	—	—	—	—	more brassy
bell metal	65-85	15-27	1-10	1-12	—	—	—	—	can be hot-forged and quenched
speculum metal	66	33	traces	—	—	—	—	—	silvery, for mirrors and reflecting telescopes; cf. the <i>Khao Kung Chi</i> figures in Sect. 36
Japanese bell metal (<i>karakane</i>)	71-89	2-8	—	5-15	—	—	—	—	Gowland (6), p. 86
	90-99	—	—	—	—	1-10	—	—	between 3 and 5% Al, handsomely 'green'-golden like
aluminium bronzes									<i>electrum</i> (<i>asem</i>)
	87	—	—	—	—	9.5	1-1.5	0.5	with Mg 1.5%; most of these alloys are as ductile, tough and malleable as mild steel
phosphor-bronze	89	9	1	—	—	—	—	< 2.5	hard, elastic, tough

^a May have 1% Sn.

^b Addition of 0.3 to 0.5% As to any alloy containing Cu greatly strengthens it at high temperatures.

^c For an excellent brief account of ancient Chinese bronze-casting, see C. S. Smith (7), pp. 107 ff.

properties, but in bronzes, on the other hand, the more ancient alloys, it is with copper the chief constituent. Here occasionally (in particular if a little zinc is present, as in bearings bronze brass) the alloy can be gold-like, but the more important domain of imitation would have been that of the high-tin bronzes, where speculum metal, for instance, used for mirrors and reflecting telescopes, is quite white and silvery. Brasses of various kinds were well known in Roman times, indeed used for coinage from about -20, but the Romans were not the inventors of the alloy, as is shown by the name which they used.^a *Aurichalcum* was a misinterpretation of the Greek *oreichalkos* (*ορείχαλκος*), the meaning therefore 'bronze of the mountains', not 'golden bronze', yet the corruption itself demonstrates the colour of the metal, which was thought to have the splendour of gold (perhaps to contain some) and the hardness of bronze. The use of calamine in the West probably goes back to the -3rd century. Pseudo-Aristotle describes a 'brilliant whitish copper', made by adding not molten tin but 'some kind of earth',^b and Theophrastus much earlier has a similar mention.^c That brasses were used in aurification appears without doubt from the +3rd-century Leiden papyrus,^d and the philosophical aurifactors certainly made them too.^e

With this we can now unfold the story of the brasses and cupro-nickels in Chinese culture, the former closely paralleling European developments, the latter unique to East Asia. One is at first repelled by what seems to be a morass of insecure data,

^a Cf. Bailey (1), vol. 2, pp. 160ff., 166ff., commenting on Pliny, *Nat. Hist.* xxxiv, i, ii, xxii ff. Also Gowland (10).

^b *De Mir. Ausc.* chs. 49, 62; 834a 1, 834b 22, 835a 9; cf. Blümner (1), vol. 4, p. 198. This text is considered to be not earlier than the +2nd century. In Pliny's time it was probably customary to 'improve' copper by adding calamine or smithsonite (the carbonate) from silver mines, or cadmia (the oxide) from copper or silver smelting-furnace flues.

^c *De Lapidibus*, 49. Cf. Michell (1), pp. 118ff. (2); Dawkins (1); Frantz (1); Hofmann (1) and especially Rolandi & Scacciati (1). Whether Strabo's *pseudargyros* (*ψευδάργυρος*) or 'false silver' was really metallic zinc (c. +20) is much disputed, but the description is not unconvincing, and he says that they made *oreichalkos* from it (*Geogr.* xii, viii, 16, 578c). Emendations by J. R. Partington (priv. comm.) now make good sense of the passage, which some think may have been a quotation from Theopompos of Chios (c. -330). In any case there is no evidence for any long-continuing or widespread industrial use of the discovery. It is true that in the excavations of the Athenian agora in 1939 directed by Shear (1), A. W. Parsons found near the Clepsydra house a small fragment of almost pure zinc sheet metal (p. 265). Subsequent study of this by Farnsworth, Smith & Rodda (1) showed that it had been hammered out while heated in the malleable range (100-250°C), knowledge of which would have been a quite remarkable metallurgical discovery. Associated objects suggested a dating in the -4th or -3rd century, but the find, still isolated, is almost as extraordinary as the aluminium belt-buckle fragments in the Chin tomb (cf. pp. 192-3); and one cannot help sympathising with Forbes (28), p. 265, who suspects an accidental modern intrusion, perhaps from a Chinese tea-chest lining!

There was *oreichalkos* of some sort in archaic Greek times (-7th cent.) because it is mentioned in the Homeric hymns (Ven. 9) and in Hesiod (*Sc. Herc.* 122), but classical archaeologists have been loth to interpret it as brass (cf. Schramm, in Pauly-Wissowa, vol. 18 (1), cols. 938ff.; Blümner (1), vol. 4, pp. 193ff.), unless it was some natural mixed-ore alloy the source of which was soon lost. On this possibility see Neumann (1). Plato (c. -360) still spoke of it as a naturally occurring gold-like metal (*Kritias*, 114E), but he had never seen any. From -200 onwards, however, as references in the plays of Plautus show, artificially made brass became well known. Cf. Caley (6).

Another ancient occurrence of brass is Semitic, that of a solitary pin with 23.4% Zn excavated at Tel Gezer near Ramleh in Israel by Macalister (2), vol. 2, p. 265; and now considered attributable to the -8th century or somewhat earlier. Presumably the Homeric explanation applies. Similar sporadic data for the Persian culture-area, central to all these civilisations, we shall consider presently (pp. 220-5 below).

On India see pp. 202-3 below.

^d Procedures no. 16, 17, 85, Berthelot (2), pp. 32, 45ff. Cf. *ibid.* pp. 55, 65ff.

^e Berthelot (2), pp. 70ff.; Sherwood Taylor (2), p. 128.

dependent on terms of uncertain meaning varying according to the historical period in question.^a But the mists clear after a time, and one finds one can rely on certain focal points—the mention of paktong in the +3rd-century *Kuang Ya* (p. 232), the doings of the Sinkiang deserters in the –2nd century (p. 219), and so on. While we cannot anticipate the definitive conclusions which Sect. 36 will hope to reach, the approximate reconstruction of what the medieval Chinese alchemists were doing is an urgent need for the readers of the present Section. To put the matter in a nutshell, brass was known, we believe, in China from the –3rd century onwards and more and more frequently used after the +2nd. Other alloys of zinc with tin and lead were also used, especially in coinage, from the –2nd century onwards, and the ‘false yellow golds’ of the earlier part of that century were assuredly brasses. Over the centuries there was a slow tendency, accelerated during the Sung period, to pass over from bronzes to brasses both for coins^b and for ornamental vessels,^c the latter often being ‘bronzed’ by a chemical dip. Zinc metal was first reduced on an industrial scale by the +10th century, and in the +18th much exported to Europe. Cupro-nickel was, we believe, known from the +1st century (perhaps from the –2nd) onwards, and more and more frequently used after the +12th. In coinage it was employed now and then from the +6th century onwards. From the end of the +16th century it was continually exported to Europe, where there was much uncertainty about its nature, but nickel metal was first obtained, not in medieval China, but in the West, by A. F. Cronstedt in +1751. The combined story was epitomised well in (Lu) Tsan-Ning’s¹ *Ko Wu Tshu Than*² (Simple Discourses on the Investigation of Things) about +980:^d

When *lu kan shih* (calamine, smithsonite) is heated with red copper it gives ‘yellow bronze’ (i.e. brass) with a colour like gold; when *phi shih* (arsenical ore containing nickel)^e is heated with it one gets ‘white bronze’ (i.e. paktong); when tin is heated with it we have resonant bronze (*hsiang thung*³).

Here the oldest alloy was named last. Exactly the same statement occurs in several other places,^f but it is noteworthy that Fang I-Chih⁴ in his *Wu Li Hsiao Shih*⁵ of +1664 says^g ‘*lu kan shih* or *wo chhien*’,⁶ this ‘poor’ or ‘mean’ lead^h being our first encounter with the classical name for metallic zinc. Actually, according to our present knowledge, Tsan-Ning could have said the same, but he was writing too soon after the first discovery of the distillation of the metal, which presumably had not in his time

^a One has also to contend with many other difficulties, the problem of sporadic chemical analyses of archaeological objects, the recognition of alloys from mixed ores, the question of when a particular percentage of a metal was ‘inadvertent’ and when not, etc.

^b See Anon. (78), analyses in Table 98.

^c See Garner (1); Chikashige Masumi (2) in Chang Hung-Chao (1), p. 336; Pope, Gethens, Cahill & Barnard (1).

^d Ch. 2, (p. 37), tr. auct.

^e Cf. Table 95, nos. 17, 129a; and p. 229 fn. c.

^f E.g. *TKKW*, ch. 14, p. 6b, cf. p. 229 below; *PTKM*, ch. 8, (p. 8).

^g Ch. 7, p. 31a.

^h N.B. not ‘Japanese’ lead, as some have wrongly assumed.

¹ 錄贊寧

² 格物叢談

³ 響銅

⁴ 方以智

⁵ 物理小識

⁶ 倭鉛

become generally known. Of course it is not to be supposed that all the artificial golds and silvers made by the Chinese alchemists in ancient and medieval times were brasses and cupro-nickels of the most simple composition, on the contrary it is probable that many were complex and sophisticated, embodying some of the more unusual metals about which we have already spoken, though in very few cases was the knowledge of the exact method of preparation handed down.

In sketching the history of the numerous non-ferrous alloys of China which could be made to resemble the precious metals, one of the greatest difficulties is that the same things did not always have the same names.^a The brasses had several, at least half a dozen, and we must consider them in turn. First, *thou-shih*,¹ the name still most common for brass today, and extremely interesting in itself, because its second character preserves the ancient tradition that it was made not by combining two metals but by adding a mineral (calamine) to a metal. But since it was evidently a metal itself and not a stone of any kind, the lexicographers tried to restore consistency in nomenclature by adding the metal radical to the second word, e.g. the *Yü Phien* dictionary of +543, which wrote *thou-shih*,² as many did afterwards also.^b It states significantly that *thou-shih* looks like gold. Sticking then to *thou-shih*, we can start from late sources and work our way back through the most significant earlier mentions of it, so as to see where they will take us. There are the descriptions one would expect in the *Wu Li Hsiao Shih* (+1664)^c and the *Pên Tshao Kang Mu* (+1596),^d but the search begins to be interesting with the *Ko Ku Yao Lun*³ (Handbook of Archaeology, Art and Antiquarianism), written by Tshao Chao⁴ in +1387 but much enlarged and revised in +1459. This text tells us that *thou-shih* (brass)^e was the essence of 'natural copper' (*tsu-jan thung*⁵), but is now made with *lu kan shih* (calamine) so that it is not the real stuff (which people in former times presumably had).^f The statement is intriguing, for the 'natural copper' in question^g could perhaps have been some mixed ore of copper and zinc from which brass was once smelted as such, but it is more probable that the reference was only to the similarity of colour between brass and the naturally-occurring ore of copper, iron and sulphur known as chalcopryite, brilliantly gold-shining.^h The *Ko Ku*

^a This is reminiscent of the converse difficulty met with when a thing changes fundamentally but still retains the same name. An outstanding case of this was the story of the steering-oar and the stern-post rudder recounted in Vol. 4, pt. 3, pp. 638ff.

^b Ch. 2, pp. 50b, 51b. *Thou* at that time and later could also be written *thou*.⁶

^c Ch. 7, p. 28a, as well as other passages.

^d Ch. 9, (p. 84), entry for *lu kan shih*.

^e Then in contemporary Europe called latten or orchal. If latten was really derived from *electrum* the connection with gold is manifested again. Orchal was of course from *orichalcum*.

^f Cit. *KHTT*, p. 1469.

^g Statements about *tsu-jan thung* in the old Chinese literature are not at all clear or consistent, but Chang Hung-Chao (1), pp. 367ff., in an interesting discussion, concluded that they must have referred to iron pyrites (FeS_2) and perhaps to arsenical ores of lead and bismuth, but mostly to chalcopryite (CuFeS_2 or Cu_2S , Fe_2S_3), some related forms of which, notably bornite, are so glittering and highly coloured as to be called 'peacock ore'. Cf. Mellor (1), pp. 377, 484; Gowland (9), pp. 57ff. Another name was *hou shih*,⁷ as in the *Pên Tshao Thu Ching*⁸ of +1062.

^h Chang Hung-Chao (8), p. 50, suggests that the whole idea of 'natural brass' arose from a confusion with the ore chalcopryite.

¹ 鎗石

² 鎗鉛

³ 格古要論

⁴ 曹昭

⁵ 自然銅

⁶ 鉞

⁷ 鉞石

⁸ 本草圖經

Yao Lun also gives the interesting information that the Koreans grind brass to form a fine emulsion, with which they paint flutes and pipes to look like gold.^a This was indeed a long anticipation of the 'bronze powders' with which Bessemer made his first fortune. Then the text goes on to quote, just as the later ones did, the words of Tshui Fang¹ about +1045 in his *Wai Tan Pên Tshao*² (Iatrochemical Natural History). This could be our first focal point.

Tshui Fang wrote:

Two catties of copper melted with one catty of *lu kan shih* (calamine) make one and a half catties of brass (*thou-shih*).^b Is it not thus obtained from a substance in the class of minerals? True *thou-shih* is produced in Persia,^c and looks just like gold; if you heat it it goes red and not black.^d

In his time the making of brass was a government monopoly. The *Sung Shih* says:^e

In the 3rd year of the Thien-Hsi reign-period (+1019) it was decreed that those who had broken the laws concerning bronze and brass should be exempted from capital punishment. . . . But after the Chhung-Ning reign-period (+1102 to +1106) the officials strictly enforced the prohibitions against private smelting. All objects and vessels of brass (*thou-shih*) were made and sold by the government only.

But some brass was also imported from the East Indies, especially from Tan-Mei-Liu,³ a kingdom in Malaya tributary to Palembang, as we know from records of tribute received, e.g. in +1000.^f

This was about the time when, as the *Sung Shih* reports,^g great play was made in Turfan (Kao-chhang) with syringes and fountains of silver and brass, the jets being made to criss-cross each other, as a public amusement. Brass vessels must now have been common in China, for Tsan-Ning twice gives a formula for removing green corrosion from them.^h The alloy was also used in China as a base for silvering, as can be deduced from the list of artificial silvers (cf. p. 279 below) given in the *Yih Hua Chu Chia Pên Tshao*⁴ written by +972.

The intensive use of brass in the +1st millennium, a time when it was much less well known in Europe, is interesting, and we shall see how far we can trace it back. The official compilation, *Thang Liu Tien*,⁵ dating from +739, has brass (*thou-shih*) in the care of a tribute official, coming from Liangchow but also from Persia.ⁱ Hsüan-

^a Cit. *Wu Li Hsiao Shih*, ch. 7, p. 28a. Cf. in Europe Theophilus, I, 28 (+1125), and Theobald (1).

^b Note the loss due to carbon dioxide and volatilisation.

^c He does not say it only came from there, but the suggestion is that it was made there from a mixed ore and not by adding calamine.

^d Tr. auct.

^e Ch. 180, p. 14a, tr. auct., adjuv. Chang Hung-Chao (2).

^f *Sung Shih*, ch. 489, p. 24a. Identification in Hirth & Rockhill (1), pp. 62, 67. A similar amount of *la*,⁶ some other alloy of zinc, came up at the same time; cf. p. 217 below. See further Hirth & Rockhill (1), pp. 78, 81; Gerini (1), p. 524.

^g Ch. 490, p. 10b.

^h *Ko Wu Tshu Than*, ch. 2, (p. 27), *Wu Lei Hsiang Kan Chih*, (p. 13).

ⁱ Ch. 22, p. 8a.

¹ 崔昉

² 外丹本草

³ 丹眉流

⁴ 日華諸家本草

⁵ 唐六典

⁶ 鐵

Chuang knew it well in India, and his *Ta Thang Hsi Yü Chi*¹ of +646 has three mentions of it, once as an ore in the earth, twice as the material for large Buddhist statues.^a Just at this time Sun Ssu-Mo included in his *Tan Ching Yao Chüeh* methods for 'doubling' or augmenting Persian brass, to make it go further.^b The *Sui Shu* again refers to brass imported from Persia about +590,^c but Tsung Lin,² in his *Ching Chhu Sui Shih Chi*³ of some forty years earlier, a book on the annual folk customs of Hupei, Hunan and Chiangsi, says that *thou-shih* was the standard metal for certain kinds of needles in all families, a use which at that time could hardly have been met by imports alone.^d One of the earliest and most interesting references to the term^e occurs in Wang Chia's⁴ *Shih I Chi*,⁵ written about +370, where he is describing Shih Hu's all-seasons bathroom. Shih Hu,⁶ whom we have met before in other connections,^f was the ruler of the Later Chao dynasty (r. +334 to +349). According to Wang Chia:

Brass (*thou-shih*) and elegant semi-precious stone was used for the sides and steps of the pool, and there were water-pots and scoops of amber. In summer a cool stream was led into it, and bags of gauze and diaphanous silk containing a variety of perfumes were suspended in the water. In frosty weather dozens of heavy bronze dragons were heated red-hot and thrown into it so that the water was warmed; these were called 'red-hot poker dragons'. Phoenix-embroidery screens protected the favourite palace girls as they relaxed with picnics and games both day and night. And it was called the 'Bathing Pavilion of Pure Enjoyment'.^g Wang Chia says that although the people used to collect the perfumed water from the drains in buckets to take home, they all enviously longed for Shih Hu's downfall, but what matters to us is the rather Victorian use which he made of brass fittings. Straddling this period come two very dissimilar references, both in Buddhist religious texts. When Kumārajīva (Chiu-Mo-Lo-Shih⁷) translated the *Saddharmapundarika Sūtra* as the *Miao Fa Lien Hua Ching*⁸ (Lotus of the Wonderful Law) between +397 and +400 he listed some of the materials used for making Buddhist images:^h

With brass (*thou-shih*⁹), with red copper and white bronze (*pai thung*¹⁰),ⁱ
 With white *la*¹¹ metal,^j with lead (*chhien*¹²) and with tin (*hsi*¹³),
 (Or else) with iron-wood (*thieh-mu*¹⁴)^k (supporting) plaster and clay,
 Or else with glue and lacquered cloth, men make and bedeck
 Majestic effigies of the Buddhas and Bodhisattvas.

^a Chs. 2, 4, 11. He also speaks of an unfinished *vihāra* (shrine?) of brass at Nālanda built by Śīlāditya Rāja (ch. 9 (Magadha, ch. 2), tr. Beal (2), vol. 2, p. 174).

^b See the discussion in pt. 3 below. He used lead, zinc and tin, giving three different processes.

^c Ch. 83, p. 15a.

^d Entry for the 7th month.

^e That *thou* was a familiar word towards the end of the +4th century appears from the fact that it was used in transliterating barbarian surnames, e.g. Thou-Wu-Lun¹⁵ in the Southern Liang dynasty (+397 to +414). This is recorded in the *Cheng Tzu Thung* dictionary of +1627.

^f E.g. Vol. 4, pt. 2, pp. 256, 287, 552.

^g Ch. 9, p. 9b, tr. auct.

^h TW 262, N 134; *Trip.* vol. 9, pp. 8.3, 9.1, tr. auct. adjuv. Chang Hung-Chao (3), cf. (1), pp. 338, 344.

ⁱ Cf. pp. 225ff. below on paktong (cupro-nickel). That is probably not meant here, but rather bronze silvered or tinned superficially.

^j Cf. pp. 214ff. below. Clearly *la* was not the same as either lead or tin.

^k Cf. Vol. 4, pt. 3, pp. 416, 645.

¹ 大唐西域記

² 宗懷

³ 荆楚歲時記

⁴ 王嘉

⁵ 拾遺記

⁶ 石虎

⁷ 鳩摩羅什

⁸ 妙法蓮花經

⁹ 鎗鉞

¹⁰ 白銅

¹¹ 鐵

¹² 鉛

¹³ 錫

¹⁴ 鐵木

¹⁵ 鎗勿倫

Similarly, when the Scythian monk Chih-Chhien¹ produced the *A-Nan Ssu Shih Ching*² (Sūtra on the Four Practices spoken to Ānanda) from some Indian source between +222 and +230, he specifically referred to brass as a substitute for gold. He wrote:^a

Worldly people are obtuse and muddled
They look at everything upside down,
They dupe themselves and deceive themselves,
As if they were buying brass (*thou thung*³) for the price of gold.

But this is as far back as we can go, and *thou-shih* fades into the mists of antiquity.^b It has been usual to suppose, with Laufer,^c that *thou* in Chinese was a loan-word from the Middle Persian *tūtiya* for calamine, which spread into Arabic and most Western languages as *tūtiyā* and *tutty*,^d but Chang Hung-Chao^e felt grave doubt about this on the ground that trade between Persia and China did not begin on any scale until after about +517, which is too late for several of the references just noted.^f We may therefore be more inclined to agree with him that the real origin was Indian, from Skr. *tāmra* (copper, brass)^g and that the word entered China with early Buddhism. But that does not mean that there were not still earlier words in Chinese for brass or other alloys of zinc. The hunt is therefore still on.

For example, there was 'yellow silver'. *Huang yin*⁴ may or may not get us back in time beyond *thou-shih*, but it is worth examining for several reasons not least because it involves two remarkable essays in the history of metallurgical chemistry written towards the end of the +12th century. In +1664 Fang I-Chih recorded the name as a standard synonym for brass,^h but it was probably never widely current, and five

^a TW 493, N 696; *Trip.* vol. 14, p. 757.1, tr. auct., adjuv. Chang Hung-Chao (3).

^b As regards brass in India there is a paper by Oppert (2) which should be re-examined. As usual, his Sanskrit authorities are difficult to interpret because the texts are so inadequately dated and the identifications of names and terms so unsure. Mentions of brass and brass-makers in the *Rāmāyaṇa* would fit in well enough with the Buddhist texts here quoted, however; and we are not surprised to find zinc metal in *post* +11th-century encyclopaedic works (e.g. Yādavaprakāśa's *Vaijayanti*, and the *Sukrantisāra*, this last a late enlargement of an older text, cf. Renou, Filliozat *et al.* (1), vol. 2, p. 129). See too Ray (1), 2nd ed., pp. 138, 153, 155, 157, 171-2.

Oppert also maintained that calamine, calaem, cadmia and *tutty* were all words of Indian origin; this too needs re-investigation.

^c (1), pp. 511ff.

^d *Tutty* did get into Chinese eventually also, but with different characters. Li Shih-Chen in +1596 lists a substance called *to-thi-ya*⁵ (PTKM, ch. 11, (p. 79), RP 135v), which significantly was used against defective vision, perhaps in cataract or trachoma cases, made up in a complex prescription of several ingredients recalling our calamine lotion. It would therefore no doubt have been the oxide or the carbonate of zinc. Li Shih-Chen gives as his authority the *Phu Chi Fang*⁶ (Practical Prescriptions for Everyman) composed by the scientific prince Chu Hsiao⁷ (Chou Ting Wang,⁸ see Sect. 38 in Vol. 6), in the near neighbourhood of +1418. Persian calamine would thus perhaps have been imported to China in the late Middle Ages along with the cobalt ore used for the ceramics industry. But both had ceased to come by Li's time, for he acknowledges that he is not quite sure what *to-thi-ya* is, and records it only pending further investigation. Cf. Chhen-Wên-Hsi (1).

^e (3), p. 131, (8), pp. 49ff., 116ff.

^f See for instance on this trade in brass (Pei) Wei Shu, ch. 102, pp. 15a, 17b and Thai-Phing Huan Yü Chi, ch. 185, pp. 15a, 16b.

^g Cf. von Garbe (3), p. 35.

^h Wu Li Hsiao Shih, ch. 7, p. 28a. Cf. de Mély (1), p. 19, on another late source.

¹ 支謙

² 阿難四事經

³ 鎗銅

⁴ 黃銀

⁵ 梁梯牙

⁶ 普濟方

⁷ 朱權

⁸ 周定王

hundred years earlier it had given rise to much perplexity, hence the following discussions. Chhêng Ta-Chhang,¹ writing about +1175 in his *Yen Fan Lu*² (Extension of the *String of Pearls* (on the *Spring and Autumn Annals*)), devoted a special section to *huang yin*.³

The emperor Thang Thai Tsung, [he said], gave Fang Hsüan-Ling⁴ (the great minister) a belt of 'yellow silver'. He wanted to give a similar one to Tu Ju-Hui⁵ (Fang's great colleague), but Tu had just died, and could not be present. The emperor said: 'According to tradition, the ghosts and demons (of disease) are very much afraid of yellow silver.' (Fang then presented it to Tu's family temple) so the emperor took another metal (*chin*⁶) belt and sent it to him as a substitute; this one must undoubtedly have been of gold (*huang chin*⁶). But as for the first belt of *huang yin*,⁷ what sort of metal could this have been?

Nowadays we are familiar with brass (*thou-shih*⁸); its basis is copper but its colour is like gold though not quite so bright. Most probably, therefore, what the emperor called 'yellow silver' was our brass. *Thou-shih* is of course a kind of metal, but the suffix *shih* is used because it is not always a natural product; it can also be made by heating and transforming *lu kan shih* (calamine). So the two things were combined under one name.^b

The *Shuo Wen* (+121) has no such word as *thou*,^c but the *Yü Phien* (+543), *Thang Yün* (+677) and *Chi Yün* (+1037) dictionaries all have it. Perhaps in early times the Han people did not know how to fuse this earth with the copper, so the mineral suffix was not added. The common saying is that true *thou* is not inferior to gold; this indicates its value. That produced from a natural source (mixed ore) is called 'true brass', while that produced by heating *lu kan shih* is called 'false' or 'substitute brass'.

The *Yuan-Ho Chün Hsien Chih* (Geography of the Yuan-Ho reign-period, +814) tells us that Thaiyuan (in Shansi) produced 'red copper' (*chhih thung*⁹). Why did it call it thus if the stuff was ordinary copper? Perhaps it was brass. But there is no proof of this in the historical records, so I would not dare to state a strong opinion.

In Sui times, when Kao Tsu was reigning (+581 to +604) Hsin Kung-I¹⁰ was Governor of Ping-chou.¹¹ Under him, threatened floods were averted, and (the mountains) produced 'yellow silver'. This was sent up to the imperial court; perhaps it was the same metal as that used by Thang Thai Tsung for the belts he made ready to present to Fang and Tu.

Nowadays people talking about *thou-shih* say that the best is produced at Thaiyuan. And Ping-chou was a former name of this place. So what (Hsin) Kung-I got was probably 'natural brass' (from a mixed ore) and not the sort made by heating and transforming *lu kan shih*. When it was presented it was called 'yellow silver' rather than 'red copper' because of its value, for it may be ranked with silver, only it is yellower.^d The use of both terms indicates its beauty. Probably the tradition about its frightening the ghosts and spirits arose because of the copper in it. . . . In any case 'yellow silver' had nothing to do with silver but was based on copper, that much we can be sure of.

^a In *Shuo Fu*, ch. 57, pp. 13a to 14a, tr. auct.

^b Explanations of this kind are often found in later literature, e.g. by Wang Chhi¹² in his *Pai Shih Hui Pien*,¹³ c. +1590, quoted by Chang Hung-Chao (8), p. 50. Cf. p. 200 above.

^c This reinforces the conclusion just suggested, that the word was a Buddhist coinage from Sanskrit.

^d This suggests a nickel-containing brass because of its whiteness.

¹ 程大昌

² 演繁露

³ 房玄齡

⁴ 杜如晦

⁵ 金

⁶ 黄金

⁷ 黄銀

⁸ 鎔石

⁹ 赤銅

¹⁰ 辛公義

¹¹ 并州

¹² 王圻

¹³ 稗史彙編

Some years later Kao Ssu-Sun¹ read these remarks of Chhêng's and wrote his own discussion of the problem. In his *Wei Lüeh*² (Compendium of Non-Classical Matters), about +1190, he said:^a

The (Thang emperor) Thai Tsung (r. +627 to +649) gave Fang Hsüan-Ling a belt of 'yellow silver'... Mr Chhêng in his (*Yen*) *Fan Lu* has enquired what sort of metal this was. It does almost seem to have belonged to the group (*shu*³) of brasses (*thou-shih*⁴). But I too have looked into the matter, and feel that brass would hardly have been precious enough to confer upon so high a minister of State.

Now the *Li (Wei) Tou Wei I*⁵ (\pm 1st cent.) says that 'a prince ruling by the power of the Metal (element) will find *huang yin*', so we know that it was an auspicious thing.

The *Pei Shih* (History of the Northern Dynasties)^b tells how when Hsin Kung-I was Governor of Mou-chou⁶ 'excessive rains beyond the eastern mountains caused dreadful flooding along the Chhen and Ju and other rivers on their way to the Eastern Sea, yet within his borders there was a great wheat harvest—the only region that did not suffer—and the mountains produced *huang yin*, which was presented to the throne', so we know that it was a strange and unusual thing.

Also Yü Shih-Nan⁷ (+558 to +638) mentioned in a stele inscription for the Temple of Confucius how (Chin) Thai Tsung (r. +371 to +372) had presented Wang Hsi-Chih⁸ (the great calligrapher, +321 to +379) with a seal of *huang yin*, as we know (also) from an (extant) address of gratitude. If *huang yin* was the same as brass (*thou-shih*) I fear this would not make sense.

Yet the (*Chiu*) *Thang Shu* (Old History of the Thang Dynasty)^c tells us that in the 1st year of the Shang-Yuan reign-period (+674) the emperor Kao Tsung issued an edict fixing pale green as the dress for officials of the 9th rank, and an ample belt of brass (*thou-shih*). So in Thang times belts of brass were certainly well known.

Now Thang Shen-Wei⁹ in the *Chêng Lei Pên Tshao*¹⁰ (Classified Pharmaceutical Natural History)^d quotes (Chhing) Hsia Tzu¹¹ as saying that 'when cinnabar is subdued by fire it turns into *huang yin* (yellow silver); this can be heavy or it can be light, with spiritual or with magic powers'. Similarly, Jih Hua Tzu¹² of the Thang^e enumerated seventeen kinds (lit. grades, *phin*¹³) of silver... including 'cinnabar silver' (*tan sha yin*¹⁴), 'realgar silver' (*hsiung huang yin*¹⁵) and 'orpiment silver' (*tshu huang yin*¹⁶). The *Pên Tshao* itself (i.e. Thang Shen-Wei) says that cinnabar, realgar and orpiment are all able to kill ghosts and demons, so if the so-called 'yellow silver' (*huang yin*) was not 'cinnabar silver' it was presumably 'realgar silver' or 'orpiment silver'. When (Thang) Thai Tsung gave (Fang Hsüan-Ling) the belt, (Tu) Ju-Hui had just died, and that was why he said that it would be good against the ghosts and demons. Again, in the Hsien-Chhing reign-period (+656 to +661) the Chief

^a Ch. 5, p. 1a, b, tr. auct. Cf. Chang Hung-Chao (1), p. 326.

^b Ch. 86, p. 18a.

^c Ch. 5, p. 5b. Cf. David (3), pp. 258, 260.

^d Kao Ssu-Sun could have used any of the editions of +1083, +1090, +1108, +1116, +1143 or +1157.

^e If this refers to the author of the *Pao Tsang Lun* (cf. p. 213) it means +918, but there were several older alchemical writings under the same name.

^f Not the Thang; the *Jih Hua Chu Chia Pên Tshao* belongs to +972.

^g The full list is considered on p. 278 below.

¹ 高似孫

² 緯畧

³ 屬

⁴ 鎔石

⁵ 禮緯斗威儀

⁶ 牟州

⁷ 虞世南

⁸ 王羲之

⁹ 唐慎微

¹⁰ 證類本草

¹¹ 青霞子

¹² 日華子

¹³ 品

¹⁴ 丹砂銀

¹⁵ 雄黃銀

¹⁶ 雌黃銀

Administrator of the Palace Guards, Su Kung,¹ was editing the *Thang Pên Tshao*,² and in that he opined that vessels made of *huang yin* would protect one against evil;^a so once more we see that 'yellow silver' was an auspicious thing.

Fang Shao,³ in his *Po Chai Pien*⁴ (written in +1117), says: '*Huang yin* comes from Szechuan, and few Southerners know about it. The courtier of the former dynasty (i.e. the Thang), Yen Ching-Chien,⁵ once found himself in charge of the Treasury, and noted that there were ten hairpins (of *huang yin*) which had been accepted in place of sums due in cash; these were made of some metal with a colour and weight no different from that of the finest gold.' If these had been of the finest grade of (*thou-*) *shih* (brass), the colour would have been quite white. Therefore from the colour we can decide (what *huang yin* was).

Both these +12th-century texts are of great interest not only for their metallurgical subject but as early examples of the history of metallurgy. Chhêng was quite certain that 'yellow silver' was brass; Kao felt that other possibilities should be envisaged. The incident of the emperor's gift to his minister, the great scholar Fang Hsüan-Ling (+578 to +648), is perfectly historical,^b and so is the governorship of Hsin Kung-I;^c but unfortunately the records disagreed as to where his charge had been, the *Pei Shih*^d saying Ping-chou in Shansi and the *Sui Shu*^e saying Mou-chou in Shantung, hence the divergences between our two early historians of metallurgy—however the only effect of this is to suspend any conclusions drawn from known products of the two places (as, e.g., in Chhêng's fourth and sixth paragraphs).^f

It is interesting that both Chhêng (sixth paragraph) and Kao (seventh paragraph) thought of the finest brass as a very pale metal. But no brass with more than about 30% Zn was possible before the isolation of zinc, hence Fang Hsüan-Ling could not have known anything like Bideri metal,^g or even brass solder (Table 102). One must therefore suspect nickel, the strongest decoloriser of copper; and arsenic perhaps as well.^h Kao starts a different hare when he refers to statements in the +10th- and +11th-century alchemical and pharmaceutical natural history literature that 'yellow silver' can be made by the use of cinnabar, realgar and orpiment. There can be no question that this refers to the whitening or silvering of surface-layers of copper and dark copper-containing alloys, by mercury and mercury vapour (so as to form a superficial amalgam), and by the formation of silvery or golden-looking surface-films containing

^a Though most of this work, more correctly known as the *Hsin Hsiu Pên Tshao*⁶ (+659), has been lost (cf. Sect. 38 in Vol. 6), Su Ching's⁷ words (Kung was a tabu form of his name used by later writers) can still be read in the part preserved in Japan, ch. 4, p. 2b. Cf. *PTKM*, ch. 8, (p. 7).

^b See *Chiu Thang Shu*, ch. 66, p. 7b.

^c It can be confidently placed from c. +590 to +600.

^d Ch. 86, p. 18a.

^e Ch. 73, p. 10a. Kao confused the two sources.

^f Thus Fang I-Chih in his *Thung Ya*⁸ (+1636) was impressed by the fact that Ping-chou was Thai-yuan, and that the best brass in his time came from that city. On the other hand Mou-chou was at or near modern Têng-chou, and we find in the Thang histories (*Chiu Thang Shu*, ch. 38, p. 37a, b, *Hsin Thang Shu*, ch. 38, p. 7a) that in Mou-chou district there was a *huang yin* 'yellow silver' mine which began production between +627 and +650. This is confirmed by the *Yuan-Ho Chün Hsien Chih* of +814. The zinc ore may thus have been discovered just in Hsin Kung-I's time.

^g So called after the town 60 miles north-west of Hyderabad where it has been made since Mogul times. See Ray (1), 2nd ed., p. 217, and further on pp. 240-1 below.

^h Cf. pp. 223 ff., 225 ff.

¹ 蘇恭

² 唐本草

³ 方勺

⁴ 泊宅編

⁵ 顏京監

⁶ 新修本草

⁷ 蘇敬

⁸ 通雅

arsenic and sulphur. These processes had been very characteristic of the +3rd-century Alexandrian aurifictors and aurifactors, but as will be clear from the Chinese evidence, they seem to go back in that civilisation at least as far.^a The variety of surface finishes that were possible comes out well from the words of Chhing Hsia Tzu when one reads the whole passage in full, easily found in the +1249 edition of the *Chêng Lei Pên Tshao*.^b Chhing Hsia Tzu goes on to say:

It (the *huang yin*) can be dark or light, and it can be dull or shining. A man can hardly lift a *hu*¹ bushel of it,^c but if ten thousand catties of it are subjected to the furnace it all soars aloft in a trice (as vapour), and even if the gods and spirits were to set out to seek for it they could not tell where it had gone.

The gods and spirits had just not heard of volatile metals and oxides, but the alchemists' realisation that no cupellable precious metal was present in *huang yin*, no matter how silvery or golden it looked, was thus admirably expressed.

The burden of evidence is then that *huang yin*, 'yellow silver', was very often if not always brass, probably containing some Ni or As, though the term may well have been used on occasion for copper or its alloys surface-altered by mercury or arsenic, as also (mostly in late times) for 'debased' gold and silver alloys like *electrum*.^d The historical data in the two passages therefore give us several further rather firm footholds for brass as *huang yin* in earlier times; from the Sung back to +814 (the 'red copper' = dark gold pinchbeck?),^e to +674 (the regulation brass belts), to +659 (the views of Su Ching (Kung) on their efficiency as demonifuges), to +630 (the date of Thang Thai Tsung's gift), then to +598 (when Governor Hsin Kung-I was enjoying Heaven's favour), and so to +372 (when Wang Hsi-Chih got his *huang yin* seal). Kao's doubts about the identity with brass rested chiefly on its not being valuable enough, but this would have varied with the period and with the exact colour of the alloy being produced at the time.^f His surprise reference comes at the end of all the others chronologically, for the *Li (Wei) Tou Wei I* is an undoubted Han text, part of the astrological-divinatory *chhan-wei* literature,^g and its title means 'Apocryphal Treatise on the Record of Rites; System of the Majesty of the Ladle (i.e. the Great Bear)'.^h Moreover, its later commentators when they came to the passage agreed that *huang yin* was a sort

^a Cf. pp. 67, 255, 257.

^b Ch. 3, (p. 80.1).

^c This could sometimes be equivalent to 60 or to 120 catties, a weight similar to the lb. avoirdupois, but it was essentially a grain measure, hence a particular volume. At the time in question here it was regarded as equivalent to 79 of our lb.

^d What Yen Ching-Chien saw in the Imperial Treasury was perhaps something of this sort.

^e See the composition given in Table 97.

^f Li Shih-Chen, in *PTKM*, ch. 8, (p. 7), shared Kao Ssu-Sun's doubts, as Chang Hung-Chao (1), p. 328, noted, presumably preferring one of the other explanations, but he did not say which.

^g Cf. Vol. 2, pp. 380, 382.

^h Li Shih-Chen (*PTKM*, loc. cit.) quotes an almost identical statement from another Han *chhan-wei* book, the *Chhun Chhiu (Wei) Yün Tou Shue* (Apocryphal Treatise on the Spring and Autumn Annals; The Axis of the Turning of the Ladle—i.e. the Great Bear). This is also full of portents and prognostications, but the statement is not to be found in the recensions available now, so either it has dropped out since Li's time, or more probably he was quoting from memory and mistook the title of the *chhan-wei* book in question.

¹ 斛

² 春秋緯運斗樞

of *thou-shih*, i.e. brass. Its mention of *huang yin* would take brass back to roughly c. +50 if not -50 or -100; and that is distinctly older than the name *thou-shih*. What other names should we look at, and can they compete in antiquity?

Perhaps the most obvious one is *huang thung*,¹ 'yellow bronze', and although it does not take us back as far as the Early Han, it does involve a passage perhaps the most pertinent and significant of all connecting brass-making with aurification and aurifaction. In the Ming and Ch'ing it was perhaps the commonest name, for we find it in *Wu Li Hsiao Shih*,^a *Thien Kung Khai Wu* (three compositions, see Table 98),^b and *Pên Tshao Kang Mu* (under *lu kan shih*).^c The term that Sung Ying-Hsing used for the best brass, like cartridge brass, with 70% copper, was *shu thung*² (refined brass), and this harks back quite a long way, to the *Wu Ching Tsung Yao* military encyclopaedia of +1044 in fact, where we meet with the same name for some of the components of the famous flamethrower.^d Ku Tsu-Yü's³ geography of +1667, the *Tu Shih Fang Yü Chi Yao*,⁴ says that much *lu kan shih* and brass came from Yunnan, a statement confirmed in several other works, such as the *Tien Hai Yü Hêng Chih*⁵ by Than Tshui,⁶ a description of the province written towards the end of the +18th century. Ku Tsu-Yü adds that coins of brass were used in the Ming from about +1520 onwards till the end of the century, and this is authenticated not only by passages in the *Ming Shih*^e but by chemical analyses (shown in Table 98). Actually it had long been a tradition to use *huang thung* in coinage, for one can find several references to this in the relevant chapters of the *Sung Shih*.^f Further back than that the name becomes rarer, but there is a good example of it in the biography of Wang Jung,⁷ a high civil and military official, indeed a kind of Vicar of Bray, of the Liu Sung, Southern Chhi and Liang dynasties, c. +490, where it occurs as part of a proverb.⁸ No earlier instance has been found.

But Li Shih-Chen's entry for *lu kan shih* and *huang thung* contains the really important passage just referred to. He quotes^h from a lost book which we would dearly like to possess now, the *Tsao Hua Chih Nan*⁸ (Guide to the Creation, i.e. Nature)ⁱ written by a naturalist and alchemist who veiled himself under the pseudonym Thu Hsiu Chen Chün,⁹ the Earth's Mansions Immortal. Li Shih-Chen used two pieces, one at the beginning and the other at the end of his entry, but we can put them together.

The Thu Hsiu Chen Chün says: 'This substance will act in transformation by projection forming a magic chemical marvellous in the highest degree (*tshu wu tien hua wei shen yao*

^a Ch. 7, p. 31a, b.

^b Ch. 14, p. 7b, Sun & Sun (1) tr., p. 247.

^c Ch. 9, (p. 84).

^d See Vol. 4, pt. 2, p. 145, where the full translation of the text is given.

^e Ch. 81, p. 8b. Finished in +1736 but on the basis of +16th-century archives.

^f Ch. 180, p. 8a. Finished in +1345 but based on records of the +10th to the +13th centuries.

^g *Nan Shih*, ch. 23, p. 6a.

^h *PTKM*, ch. 9, (p. 84).

ⁱ On the proper understanding of this title see Vol. 2, p. 564, Vol. 3, p. 599. One of us (N. S.) suggests for *Tsao Hua* 'The Shaping Forces (of Nature)'. Cf. p. 93 above.

¹ 黃銅

² 熟銅

³ 顧祖禹

⁴ 讀史方輿紀要

⁵ 瀛海虞衡志

⁶ 檀萃

⁷ 王壘

⁸ 造化指南

⁹ 土宿眞君

*chüeh miao*¹). Bearing the name of "Mr Furnace" (Lu hsien-sêng²), it is honoured throughout the Nine Heavens and by the Three Pure Ones; indeed it is no ordinary chemical.'

The *Tsao Hua Chih Nan* says: 'Lu kan shih is endowed with the *chhi* of yellow gold and white silver. It has to be smoked (by the exhalations of the earth) through a period of thirty years before its development is completed. After (fermentation) at dung (heat) with arsenical substances, it can be used in (alchemical) transformation by projection (*chieh kho tien hua*³). It does not diminish the (effects of the) "three yellows".'^a

This is extremely significant for it practically proves that many of the artificial golds produced by the Chinese aurifictors and alchemists were brasses of suitable composition. To speak of projection in connection with zinc (and of nickel too, for that metal is also clearly implied by the reference to arsenic, nickel arsenides being among the commonest of its ores) tells its own story unequivocally—'he added a certain mineral or chemical, and it all turned to gold', or silver, as the case might be. Li Shih-Chen himself understood it in this way, for in the same place he says: 'Lu kan shih is the precursor of gold and silver (*chin yin chih miao yeh*⁴)', and also: 'All sorts of brasses (*huang thung*⁵) are made by projection with this material (*chieh tshu wu tien hua yeh*⁶).' It is regrettable that we are not yet in a position to date the *Tsao Hua Chih Nan* precisely, but its style recalls Thang and Sung Taoist writings much more than the explicitness of the Ming, and we suspect that it should be placed either in the +10th century (Wu Tai) with the *Pao Tsang Lun*, or else in the +11th, with the *Wai Tan Pên Tshao*. The general suggestion which we thus reach is that probably from the earliest times of Chinese aurifiction and alchemical aurifaction onwards, i.e. no later than the beginning of the -2nd century and perhaps some time before, brasses of various compositions are the explanation of what was done.^b Weighty authorities have expressed the same view.^c

It is moreover supported by facts revealed in the unravelling of a queer group of ancient obsolete technical terms. One can be sure that they involved zinc-containing alloys, probably of several sorts, including the brasses, but it is not too easy to find out exactly what these were. They all belong to the centuries before the isolation and regular manufacture of metallic zinc, so before considering them it will be best to fix

^a This last remark must refer to sulphur, orpiment and realgar (cf. p. 275). What presumably it means here is that even after the brasses and cupro-nickels have been made, their castings or ingots can still be considerably adjusted in colour and glitter by surface-films resulting from the action of sulphides, polysulphides, and various forms of arsenic—in other words 'bronzing' by vapours or 'dips'.

^b Most probably an enigmatic statement in the *Shen Nung Pên Tshao Ching*, undoubtedly a Han text, is really a witness of this. In its entry for malachite, copper carbonate (*khung chhing*?), it says that this will turn copper, iron, lead and tin all into gold (CLPT, ch. 3, p. 90.2). Iron can be accounted for by the 'wet copper' precipitation (cf. p. 245), but the other three would have been constituents of low-zinc brasses. It must be remembered that *lu kan shih* did not appear in the pharmaceutical natural histories till the +16th century (PTKM, ch. 9, p. 84), and the Han writer may have confused calamine with other minerals. But Thao Hung-Ching (CLPT, loc. cit.) still said that 'copper carbonate' would turn lead to gold, after mixing with other things.

^c E.g. Chang Hung-Chao (1), pp. 341, 343, (2), p. 26, (3), p. 130, (6) and (8), pp. 55, 118; Chang Tzu-Kao (2), p. 83.

¹ 此物點化為神藥絕妙

² 爐先生

³ 皆可點化

⁴ 金銀之苗也

⁵ 黃銅

⁶ 皆此物點化也

⁷ 空青

Table 98. Chinese historical and analytical data on coin compositions (percentage compositions)

	Cu	Sn	Zn	Pb	Fe	
C/Han coin of -186	61	10	1.5	25.5	1.5	anal. Chang Hung-Chao (1), p. 343
Han coins	81.9	5.4	2.9	0.9	2.3	anal. Anon. (78)
C/Han coins of -175	75	18.5	4	trace	1	n.b. before the anti-coining edict of -144 anal. Chang Hung-Chao (1), p. 342
Hsin coin of +9	91	trace	7	0.5	0.5	anal. Chang Hung-Chao (3), cf. (1), p. 340. Pb and Fe probably from the Cu ore
Thang, mint bulk figures, +752	83.5	2	14.5	—	—	like good casting brass, <i>la</i> taken as Zn
Thang coins	70.1	12.7	1.1	12.3	—	perhaps Zn, Pb and Sn all contained in <i>la</i> ; ^a anal. Wang Chin (2), p. 34 from Anon. (78)
Khai-Yuan r.p. (+713 to +742)	71.9	13.7	1.4	12.9	—	anal. Y. L. Kao (1).
Sung, <i>Wai Tan Pên Tshao</i> formula for brass (<i>thou-shih</i> ¹) +1045	80	—	20	—	—	like best modern brass, if no great loss by volatilisation
Sung, mint bulk figures, for <i>chia hsi</i> <i>chhien</i> ² coins c. +1092	57	—	14.5	28.5	—	see text, p. 215
Sung coins						
Shao-Shêng r.p. (+1094 to +1098)	55.5	3.1	13.1	25.8	1.5	anal. Chang Hung-Chao (2), p. 21
Yuan-Yu r.p. (+1086 to +1094)	61.5	8.1	2.2	25.4	2.1	anal. Anon. (78)
Hsi-Ning r.p. (+1102 to +1107)	69.3	13.9	1.2	15.6	trace	anal. Anon. (78)
Yuan coins						
Yuan-Thung r.p. (+1333 to +1335)	65.1	—	4.7	26.1	—	anal. Y. L. Kao (1)

Ming coins	—	—	98.5	—	—	Sage (1); Leeds (1) anal.
Yung-Lo, Hsüan-Tè, Lung-Ching and Thai-Chhang r.p.s. (+1402 to +1572, and +1620)	—	—	—	—	—	
Wan-Li r.p. (+1573 to +1619)	48.5	6.5	31.7	1.4	2.4	anal. Anon. (78)
Wan-Li r.p. (+1573 to +1619)	—	—	20.9	—	—	anal. Y. L. Kao (1)
Ming, <i>Thien Kung Khai Wu</i> formulae, +1637						
<i>hsiang thung</i> ³ (resonant bronze)	80	20	—	—	—	for gongs, etc., cf. pp. 197, 199
<i>san huo (shao) huang thung</i> ⁴ } (brass)	70	—	30	—	—	best, like cartridge brass
<i>ssu huo shu (huang) thung</i> ⁵ }						
<i>huang thung</i> ⁶ (brass)	60	—	40	—	—	standard quality, like Muntz metal
<i>ti chhi thung</i> ⁷ (brass)	40-50	—	50-60	—	—	cheapest, like white brass
Chhing coins						
Khang-Hsi r.p. (+1662 to +1723)	50.7	4.2	24.4	3.7	1.9	anal. Anon. (78)
Chhien-Lung r.p. (+1736 to +1796)						
'white'	52.8	4.3	37.9	3.2	0.7	anal. Anon. (78)
'red'	47.9	1.8	44.9	0.9	4.7	anal. Anon. (78)
Kuang-Hsü r.p. (1875 to 1908)	54.7	1.0	40.6	1.1	2.3	anal. Anon. (78)
Chhing, <i>Wu Li Hsiao Shih</i> formulae, +1664						
<i>huang thung</i> ⁶ (brass)	62.5	—	37.5	—	—	
<i>chhien thung</i> ⁸ (coinage brass)	40	—	60	—	—	brittle, white, and liable to darken

¹ 鎗石

² 夾錫錢

³ 響銅

⁴ 三火(燒)黃銅

⁵ 四火熟(黃)銅

⁶ 黃銅

⁷ 低器銅

⁸ 錢銅

^a For an appreciation of much that will follow (pp. 214ff.), it is necessary to remember that Zn and Pb alone together are completely miscible only above 790 °C., while at temperatures approaching 1000° the former boils off. As they cool, a very large 'miscibility gap' appears, so that eventually the metals separate into two layers, the Zn floating on the Pb, with less than 2% of each genuinely dissolved in the other. But, in the presence of Sn (from 10 to 75%), almost all proportions of Zn and Pb will consort together in true ternary alloys. Some of these have been used for small castings and for printing type metal (cf. Hiorns (2), p. 330, and the current standard metallurgical handbooks). We shall suggest that in China from ancient times onward Sn ore was knowledgeably added to the mixed Zn-Pb ores so that the Zn was caught as effectively as by Cu in the classical brass-making process. Alloys of this kind have useful properties, for the Zn hardens the Sn when cold and the Pb improves its fluidity when molten.

The verification and reproduction of this 'cementation' invites laboratory experiments, since (so far as we know) it has not been performed in recent centuries either in China or elsewhere. If it should prove not feasible, the only alternative will be to interpret *la, lien*, and the other medieval metals in question as Zn itself; and so to put back the date of its first isolation to the Han (—2nd to +2nd century) rather than the Wu Tai (+10th century, cf. p. 213). This would be the less difficult to believe because the use of coal for the smelting of iron by crucible methods is ancient in China, dating from the +4th century at least; cf. Needham (32), p. 14; Read (12). Suitable temperatures produced by coal piles could therefore have been reached. Lastly, if metallic Zn really was available in China from the Han onwards, high-Zn brasses could indeed have been made, and our cautions about this expressed at several points in the sub-section would become unnecessary.

the time of this. We place it very early in the +10th century, if not in the previous one, so that it would have been an invention of the late Thang period. Following the procedure we have been using, let us work back to this focal point starting from late sources.

(ii) *The origins of zinc*

In +1745 the ship *Gotheborg* was wrecked on a submerged rock near Gothenburg, her home port in Sweden, with the loss of a full cargo of porcelain, silk, tea and zinc, loaded at Canton eighteen months previously. About 1870 divers recovered most of the porcelain and some of the zinc ingots; these, upon analysis in 1912, proved to be of a purity corresponding to 98.99% Zn, no copper, nickel, silver, arsenic or lead being present, only a little iron and antimony.^a 'The beautifully bright fracture and the purity of this zinc', wrote Hommel, 'would certainly be the delight of more than one manager of our own days, who has to resort to all kinds of impure ores with which to fill his retorts.' And indeed under the name of *tutenag* (derived from *tūtiya* already mentioned, but spelt in a hundred curious ways)^b zinc metal had been an important article of export commerce from China to Europe since about +1605.^c Though rightly identified with 'spelter'^d and used to make brass, its origin and preparation were not understood. On 29 May 1679 Sir Thomas Browne wrote to his son asking 'what is toothanage?' In +1751 the industrial lexicographer Postlethwayt (1) still did not know how it was made, but Staunton, as the result of his visit to China with the Macartney embassy, understood it well and explained it in his book of +1797. From +1699 onwards zinc was used for air-tight containers in the tea trade, usually in the form of an alloy with lead and tin known as 'canister metal'.^e The encyclopaedists of East Asia were not always themselves much clearer in the mind about zinc, as one can see from the entry in the *Wakan Sanzai Zue*^f of +1712, based on Wang Chhi's² *San Tshai Thu Hui*³ of +1609.

*Aen*⁴ (*ya chhien*⁴), also called *totamu*,⁵ a word^f derived from some foreign language.

We really do not quite know what this (metal) is, but it belongs to the category (*lei*⁶) of lead, wherefore it is called 'inferior lead' (*ya chhien*⁴). It comes in plates over a foot long, five or six inches wide and less than an inch thick. It is obtained by smelting. There is also a kind called 'medicinal rubbings' (*yakuken*⁷), which may be in appearance like flower petals (probably flakes).

That which comes from Kuangtung province is the best, while that from Pa-niu in Tung-ching (Indo-China) is less good in quality. Nowadays in the making of vessels of brass (*kara*

^a W. Hommel (1).

^b See Bonnin (1), pp. 3 ff. There was great confusion for three centuries in Europe in the naming of the two great metal exports from China, *tutenag* (hence 'tooth-and-egg metal') being properly zinc, and *paktong* properly cupro-nickel (cf. pp. 225 ff. below).

^c Abundant references will be found in Bonnin's book. Between +1760 and +1780 the U.K. alone imported about 40 tons a year.

^d See Dawkins (1).

^e This is particularly significant in view of what follows, p. 214 below. Bonnin (1), p. 69.

^f Obviously again from *tūtiya* and *tutty*.

¹ 和漢三才圖會

² 王圻

³ 三才圖會

⁴ 亞鉛

⁵ 止多牟

⁶ 類

⁷ 藥研

kane,¹ *thang chin*¹; ^a *shinchū*,² *chen thou*²)^b it is indispensable to add *aen*, so this metal is very valuable. It is probably made by the transformation of calamine (*lu kan shih*) in furnaces.

The pharmaceutical natural histories say that calamine ore was mixed with copper to make brass (*thou-shih*³); there is no doubt of this, but we are not sure how it was done.^c

Other writers were more precise, and good statements can be found in the *Wu Li Hsiao Shih* of +1664,^d while the classical account of zinc metal distillation occurs in +1637 in the *Thien Kung Khai Wu*.^e In all these texts the term for zinc is *wo chhien*,⁴ 'poor' or 'mean' lead, but Sung Ying-Hsing was mistaken in saying, as he did, that this was a modern one, and implying that zinc had not long been known.

Before giving the oldest occurrence of the name that we can find, a word must be said about the use of almost pure zinc coins in the Ming dynasty earlier than the time of Sung Ying-Hsing, a practice which continued late into the Chhing (Fig. 1323). The nature of this metal (97.6 to 99% pure) was first realised by Sage (1), who in 1804 analysed a coin which may have been contemporary with him and cannot have been older than +1723. A careful study by Leeds (1) long afterwards revealed that the minting of these matt grey coins could be demonstrated from +1402 onwards, through the Yung-Lo and Hsüan-Tê reign-periods, again in the middle of the +16th century, and for the first four decades of the +17th,^f then onwards from the beginning of the reign of the Khang-Hsi emperor in +1662. Chinese historical records of the Ming often mention brass coinage,^g but so far no textual reference has been found to the use of the *wo chhien* metal alone.

We are now in a position to look at the oldest occurrence of this term. It is in the *Pao Tsang Lun*⁵ (Discourse on the Precious Treasury of the Earth), datable to +918, and it occurs in a discussion of lead and its relatives. Chhing Hsia Tzu⁶ (whoever he was) said:^h

Of lead there are several sorts. The lead from Persia, hard and white, is the best there is. 'Nodal' lead (*tshao chieh chhien*⁷) comes from Chien-wei⁸ (modern Chia-ting in Szechuan); it is the essence of silver.ⁱ 'Silver-restraining, or controlling' lead (*hsien yin chhien*⁹) is the lead from silver mines; it harbours within it the five colours, which is truly marvellous.^k Then there is the lead from Shang-jao¹⁰ (in Chiangsi) and that from Lo-phing¹¹ (in Shansi),

^a Strictly this is bronze; *huang thang chin*¹² (*kōkarakane*¹²) was meant, lit. 'yellow Chinese metal'.

^b Note how by this time the ancient distinction between 'true brass' made from a mixed ore, and 'false brass' made by adding calamine to copper, had quite disappeared.

^c Tr. auct., adjuv. de Mély (1), text, p. 34, tr. p. 41.

^d Ch. 7, pp. 5a, 31a, 32a.

^e Ch. 14, p. 8a, tr. Sun & Sun (1), pp. 247, 258. We reserve our translation and comments for Sect. 36. Meanwhile cf. Julien & Champion (1), p. 46; Biot (17).

^f At this time the Japanese were also using zinc in their coins (analyses in Anon. 78), but not, so far as we know, zinc only.

^g E.g. *Ming Shih*, ch. 81, p. 8b; *Wu Li Hsiao Shih*, ch. 7, p. 31a, b.

^h Preserved in *PTKM*, ch. 8, (p. 12), tr. auct.

ⁱ This may be a reference to the intimate association of the two metals in cupellation.

^j This clearly means argentiferous galena (lead sulphide, cf. Gowland (9), p. 135), still supplying so much of the world's silver.

^k Presumably a reference to iridescent colours on surface-films of molten lead.

¹ 唐金

² 眞鉛

³ 鉛石

⁴ 倭鉛

⁵ 寶藏論

⁶ 青霞子

⁷ 草節鉛

⁸ 隄爲

⁹ 銜銀鉛

¹⁰ 上饒

¹¹ 樂平

¹² 黃唐金

second only to that from Persia and Chien-wei. Fu-pan¹ lead is the precursor (*miao*²) of iron, and cannot be used.^a *Wo chhien*³ ('poor' lead, i.e. zinc) can however be alloyed with other metals (*kho kou chin*⁴).^b

Wo chhien was probably not the only term for zinc metal at this period, for we sometimes meet with the expression *pai chhien*,⁵ 'white lead', as in the *Tan Fang Chien Yuan*⁶ (Mirror of Alchemical Processes and Reagents), written by Tuku Thao⁷ just before the Sung, i.e. about +950.^c This is a term which has continued in use, along with *wo chhien*, down to the present time,^d contrasting with *hei chhien*,⁸ 'black lead', which has always meant lead itself. The thing to remember then is that we can be sure of the existence and use of isolated zinc metal from +900 onwards.^e

Returning now to the group of ambiguous ancient words,^f we have to consider *yin*,⁹ *pai hsi*¹⁰ (white tin), *hsi*¹¹ (tin), *hsi la*¹² or *hsi* and *la*,¹² *pai la*,¹³ *lien*^{14, 15} and *lien hsi* or *lien* and *hsi*, finally also *lien*.¹⁶ Here it will be easier to reverse the method we have been using, and proceed from the most ancient mentions onwards. When the *Shan Hai Ching* (Classic of the Mountains and Rivers, c. -6th to -3rd century) speaks of *pai hsi*¹⁰ produced at a mountain site^g it has been thought to mean tin, yet Kuo Pho in his commentary, c. +300, says that *pai hsi* is the same as *pai la*.¹³ In the *Erh Ya* dictionary (c. -4th century) *yin*⁹ is given as a synonym for *hsi*¹¹ (tin),^h yet Kuo Pho comments again about +300 that this is the same as *pai la*.¹³ The *Yü Phien* dictionary (+543) connectsⁱ by saying that *yin*⁹ is the same as *pai hsi*.¹⁰ One might then write off *pai hsi*,

^a An enigmatic statement which may conceal something interesting, but so far not interpretable.

^b So we translate, taking *kou* for *kou*¹⁷ or *chü*¹⁸; but it would be bolder to say 'can inveigle (people into accepting false) gold'.

^c Ch. 1, cf. Fêng Chia-Lo & Collier (1).

^d It probably accounts for the 'packyyn' of +18th-century Europe.

^e Perhaps the oldest reference to the export of zinc metal from China occurs in the *Nukhat al-Dahr* (Cosmography) of Abū Abdallāh al-Dimashqī, c. +1300 (tr. Mehren, cit. Forbes (3), p. 284, (28), p. 273). He said it was white like tin, not easily oxidisable, and with a dull sound when struck. On the many much earlier Arabic accounts of peculiar metals from China see p. 238 and pt. 4. As for the history of zinc in the West see Partington (7), vol. 2, pp. 108ff. and Dawkins (1). According to the description of von Löhneys (1) it was made occasionally and in small quantities at Goslar in Germany as early as +1600 (Fester (1), p. 70; cf. Sisco & Smith (1), pp. 271ff.). Zinc was first smelted in England about +1680 with calamine from the Mendips, and the oldest regular manufacture was started at Bristol by Wm. Champion in +1743. Torbern Bergman (or perhaps rather his pupil B. R. Geyer) stated in +1779 that 'a certain Englishman made several years ago a voyage to China for the purpose of learning the art of smelting zinc or tutenago, but though he became sufficiently instructed in the secret and returned safely home, he carefully concealed it' (cf. Bergman (1), dissertation no. xxxii, *De Mineris Zinci*, in vol. 2, p. 309, Eng. tr., vol. 2, p. 317; quoted in Cronstedt (1), 2nd ed.). The person in question may well have been a Scot, Isaac Lawson, who took his doctorate at Leiden with a thesis on zinc in +1737, but the Bristol production had by then already for half a century been secret, and even in +1766 it was still 'hush-hush' when Bp. Watson was allowed to see it.

^f It is interesting that the word adopted by the chemical terminologists in modern times for zinc, *hsin*,¹⁹ occurs already in the +6th-century *Yü Phien*, where it is said (ch. 2, p. 51b) to be equivalent to *tsu*²⁰ or *tsu*,²⁰ meaning 'hard', and also to be 'the offspring of gold (*chin erh*²¹)'. Possibly this has an alchemical or aurifictive significance, denoting a gold-looking brass with or without a little gold, hence betraying the presence of the hardener zinc—in which case the modern choice of the character for the metal was an excellent one. On the formation of the terminology of modern chemistry cf. pt. 3.

^g Ch. 5, p. 25a, the entry for Huan Shan;²² cf. de Rosny tr. (1), p. 253.

^h Ch. 6, p. 6b.

ⁱ Ch. 2, p. 49a.

¹ 負版鉛

² 苗

³ 優鉛

⁴ 可勾金

⁵ 白鉛

⁶ 丹方鑑源

⁷ 獨孤稽

⁸ 黑鉛

⁹ 鉛

¹⁰ 白錫

¹¹ 錫

¹² 錫鐵

¹³ 白鐵

¹⁴ 連

¹⁵ 鐵

¹⁶ 鐵

¹⁷ 句

¹⁸ 拘

¹⁹ 鋅

²⁰ 鈺

²¹ 金兒

²² 離山

la and *pai la*, as simply tin, were it not for the fact that in subsequent centuries they demonstrably mean something else. Consequently this something may have existed in Kuo Pho's time, and he (after all a layman) may have confused it with tin.

We must follow the fortunes of all these words and phrases independently, if not quite in chronological order. One of the interesting features of the economics chapters of the dynastic histories is that when speaking of coinage they sometimes give aggregate figures for the amounts of metal used yearly in the official mints, hence the composition of the prevailing alloy can be estimated, and this can sometimes be confirmed by chemical analysis of extant coins. Thus in the *Sung Shih*, relating to about the year +1092 and the premiership of the reformer Tshai Ching¹ (+1046 to +1126), we can read:^a 'He now advocated the use of "mixed-tin money" (*chia hsi chhien*²). . . For the making of every thousand coins, there were used eight catties of copper, four catties of black tin, and two catties of white tin.' Thus in a simple ratio there was 'black tin' and 'white tin' but not ordinary tin. From the *Yü Phien* dictionary we know that *hei hsi*³ (black tin) was lead,^b so it would seem that the 'white tin' was zinc; and this is strikingly confirmed (cf. Table 98) by modern analysis of coins from the Shao-Shêng reign-period (+1094 to +1097), though those of neighbouring periods do not contain much zinc.^c The agreement is even quantitative, 14.5% Zn being expected from the text, and 13.1% obtained. Stepping back a little, *pai hsi chin*⁴ occurs in the list of artificial golds^d given by the *Pao Tsang Lun* (+918), where it may mean some form of 'debasement', probably using tin, zinc and lead; and *pai hsi yin*⁵ similarly occurs in the parallel list of false and true silvers given in the *Jih Hua Chu Chia Pên Tshao*,^e indicating an alloy based on a similar dilution of the precious metal.^f Since all these dates fall within the metallic zinc period we need not be hesitant in the identification, though perhaps *pai hsi* also meant (especially in earlier times) an alloy of zinc with tin and lead.^g The term occurs sporadically later with the meaning of zinc (or its alloys), as in the *Chin Tan Ta Yao Thu*⁶ of +1331, an important epitome of alchemy valid for its physiological as well as its laboratory form;^h and again in a travel book, the *Tao I Chih Lüeh*⁷ of c. +1350, the author of which, Wang Ta-Yuan,⁸ found plenty of it in the Malayan country Tan-Mei-Liu already referred to (p. 201).ⁱ But then it seems to die out, presumably because *wo chhien* became the dominant term for metallic zinc.

Now for *la*, *hsi-and-la*, and *pai la*.^j While for Kuo Pho in the Chin (c. +300) *pai la*

^a Ch. 180, p. 196, tr. auct., adjuv. Chang Hung-Chao (2).

^b Ch. 2, p. 51a.

^c But late Ming coins have still more (Table 98).

^d Considered fully on p. 275 below.

^e See also p. 279 below.

^f Both lists have also a *hei chhien chin*⁹ and a *hei chhien yin*,¹⁰ undoubtedly referring in various contexts to lead, which has always borne the cognomen 'black'.

^g Very probably so in the Han and San Kuo periods, conceivably even in the Chou time when the *Shan Hai Ching* was put together.

^h See Ho Ping-Yü & Needham (2), p. 197, and further in pts. 3 and 5 below. *TTCY* ed. p. 34a.

ⁱ Ch. 1, tr. Rockhill (1).

^j *La* itself is a very old word, a bit vague, like so many of the ancient words for metals. It is met with in bronze inscriptions of the Chou period in the expression *chhih la*,¹¹ 'red la', which must have meant that metal (priv. comm. from Dr Chêng Tê-Khun).

¹ 蔡京

² 夾錫錢

³ 黑錫

⁴ 白錫金

⁵ 白錫銀

⁶ 金丹大要圖

⁷ 島夷志略

⁸ 王大淵

⁹ 黑鉛金

¹⁰ 黑鉛銀

¹¹ 赤鑠

was simply a synonym of tin (*hsi*), it was obviously something else, perhaps better known, in the Sui. The *Yü Phien* (+543) defines *la* as 'the *la* that goes with *hsi* (tin)' or 'the *la* of tin' (*hsi la yeh*).^a Referring to +585 the *Sui Shu* says:^b

At that time (i.e. formerly) much coinage was used which was partly of tin and *la*. Now *hsi* and *la* were cheap, and many were anxious to make profit thereby. Private minting therefore could not be stopped, but now an edict forbade it, closing the tin and *la* refineries so that the casting (of such coins) by individuals among the people could not go on.

So *la* was not tin but something associated with tin. This is proved again by the *Hsin Thang Shu* in several places. It says, for instance, that in the I-Fêng reign-period (+676 to +678) there was much private coining with copper, tin and *la*, as also in the Thien-Pao reign-period (+742 to +755).^c It then goes on:^d

In the 11th year of the Thien-Pao reign-period (+752) there were in the whole country ninety-nine mints, with thirty workers in each. Each mint manufactured annually 3,300 strings of cash,^e using for this purpose 21,000 catties of copper, 3,700 catties of *la* and 500 catties of tin.

The resulting composition, if *la* at this earlier period was already zinc, is shown in Table 98, but coin analyses from a neighbouring period do not support that assumption. *La* could conceivably have been a brass, but more likely it was an alloy of tin and lead with some zinc; then the figures might well agree. Triple alloys of this kind may indeed give the clue to the solution of the whole problem even far back into antiquity.^f

The coinage techniques used in the Thang seem to have been continued during the Sung, perhaps even after the distillation of zinc from calamine had been discovered, judging at least from an interesting text relating how a metallurgical expert of the former Southern Thang dynasty was commissioned to report on the best methods for adoption. The *Sung Shih* says:^g

There was a scarcity of copper, tin and lead, and doubt about the best alloy. After enquiry there was found among the Administrative Secretaries a man named Ting Chao,² who had been an official at the court of the Southern Thang dynasty (+937 to +958, in the Wu Tai period), and who knew Jao (-chou)³ and Hsin (-chou)⁴ and other regions where there were mountain valleys producing copper, tin and lead. This civil servant was accordingly given authority to investigate the former methods of casting and to call up men to mine the deposits of ores. The result was that the methods used at Yung-phing⁵ were found to be the best, and these were the same as those which had been used in the Thang dynasty during the Khai-Yuan reign-period. In due course Ting Chao returned to the capital to make his report.

^a Ch. 2, p. 52a.

^b Ch. 24, p. 22a, b, tr. auct.

^c Ch. 54, p. 5a.

^d Ch. 54, p. 6b.

^e I.e. 3,300,000 coins, according to Chang Hung-Chao (2), p. 23.

^f On the numismatic aspects of these 'white coins' (*pai chien*) of Sui and Thang, see Chang Hung-Chao (8), p. 103, with references. The use of *hsi* and *la* in minting seems to have started in +528 in the Northern Wei dynasty.

^g Ch. 180, p. 3a, b, tr. auct., adjuv. Chang, loc. cit.

¹ 錫鐵也

² 丁釗

³ 饒州

⁴ 信州

⁵ 永平

⁶ 白錢

All this took place about the year +977. If it implies, as seemingly it does, that *la* continued in use during the Sung, the regularly high amounts of lead in the coins, together with the varying amounts of zinc (analyses in Table 98), could be explained by an irregular composition of the product derived from mixed ores, metallic zinc perhaps being sometimes volatilised and lost more fully than at other times. Finally *la* appears again as part of the tribute of the Malayan country of Tan-Mei-Liu in +1000;^a this is clear evidence that there was an important source of zinc there, whence came brass itself (p. 201 above) as well as what may be suspected of being a variable-content Zn-Pb-Sn alloy (p. 215 above). Once again, after the +10th or +11th century the name of *la* dies out,^b presumably because the new availability of metallic zinc ruined the old production and import of the mixed product of zinc, lead and tin.^c

We have still not dealt with *lien*,^{1, 2, 3} but it is rewarding in that it takes us back further than any of the terms in the preceding paragraphs. It occurs in the *Shih Chi* (finished by -90), which says that *lien*¹ and *hsi*⁴ (tin) are produced near Chhangsha (in Hunan).^d Hsü Shen (+121) gives it the metal radical and explains it as belonging to the class of copper (*thung shu yeh*⁵).^e No one has found the word in pre-Han writings so far but there are several occurrences of it in the *Chhien Han Shu*, e.g. in relation to government requisitioning in +10,^f and especially in connection with Wang Mang's coinage. It says^g that 'when Wang Mang ascended the throne (in +9, as the first and only Hsin emperor) he changed the rules of the Han and made coins of

^a *Sung Shih*, ch. 489, p. 24a.

^b Or rather, takes a new lease of life in more recent times as a binome, *hsi-la*,⁶ for solders, soft solders being mixtures of tin and lead with small amounts of other constituents such as bismuth (Table 102), and hard solders for brass having in addition copper and zinc (cf. Hiscox (1), pp. 655ff.).

*Pai la*⁷ also lived on, as the name of pewter, an alloy mostly containing lead and tin (see Table 102). How far the making of this goes back in China is not very clear, perhaps not much before the Ming. The absence of a specific name renders investigation difficult. In modern times Wênchow and places near Swatow were the great centres of its manufacture (cf. R. P. Hommel (1), pp. 354ff.), and it was much used for altar furniture both in temples and homes. One of us (G. D. L.), when working at the Lester Institute in 1930 with Dr Ben Platt and Mr Rewi Alley, used often to see the 'lead line' on the gums of Chiangsu country people; presumably it was due to the use of pewters too high in lead. Shang bronzes can have up to 20%, so they may have been dangerous if used for food (cf. Kobert, 1).

Pewter has also been prominent in Japan, as *byakurō*⁸ or *shirome*.⁹ But the second reading also means white solder, paralleling *kōrō*⁸ (hard solder), *chūrō*⁹ (middling solder) and *hayarō*¹⁰ (quick solder). *Shirome* has however a further meaning, the pseudo-speiss of Cu, Pb, As and Sb produced in the Japanese liquation process (Gowland (11), cf. Table 102) and often added to bronze. Fourthly, as *Iyo-shirome*,¹¹ it means metallic antimony. Early references to *shirome*, whatever it was, occur in +698 and +768 (*Wakan Sanzai Zue*, de Mély (1), text, pp. 27, 37, tr., pp. 33, 43). Yet another use of the term *la* is found in Japan, *ginrō*¹² (*yin la*¹²) designating an alloy of silver with Zn, or with Zn and Pb (cf. 'silver-zinc' in Table 100, and Hiorns (2), p. 396).

^c See p. 211, fn. a.

^d Ch. 129, p. 12a. Cf. Swann (1), p. 445. Chang Hung-Chao (2), p. 24, notes that in the +16th century much *lu kan shih* (calamine) and hence brass came from Hunan and Hupei (PTKM, TKKW); and this may indeed be not without significance.

^e *Shuo Wen*, ch. 14A, (p. 293.2).

^f Ch. 24B, p. 22b: 'Craftsmen and tradespeople who were able to produce gold, silver, copper, *lien* and tin, or to present tortoise-shells, or to collect cowries; all were required to make a declaration (of their possessions), so that the seven Market Treasurers could requisition (what was necessary) according to the seasons and the fortnightly periods of the year.' Cf. Swann (1), p. 337.

^g Ch. 24B, p. 21a. Cf. Swann (1), p. 331.

¹ 連

² 鐵

³ 鐵

⁴ 錫

⁵ 銅屬也

⁶ 錫鐵

⁷ 白鐵

⁸ 硬鐵

⁹ 中鐵

¹⁰ 早鐵

¹¹ 伊豫白鐵

¹² 銀鐵

copper mixed with *lien* and *hsi* (*chieh yung thung, hsiao i lien hsi*¹).^a Modern analyses of Hsin coins^b show that they are mostly copper, with variable amounts of other metals, tin up to 7%, zinc up to 7% and lead up to 12%. This would be consistent with the intentional addition of small amounts of tin, and of zinc-lead-tin alloys of variable composition; these other metals can certainly not have been impurities in the copper, especially as the literary evidence states that *lien* and *hsi* were added. What is further interesting is that the *Han Kuan I*,² a book on the Han bureaucracy written or published by Ying Shao³ in +197, says that Wang Mang's coins were called *Pai Shui Chen Jen*,⁴ i.e. 'White-Water Adepts', a distinct indication of the role of his Taoist alchemists in the 'adulteration' of the bronze. It only remains to add that in recent centuries the word *lien*⁵ has been used for zinc in Yunnan province. This change of orthography may perhaps have been a local usage accompanying the change from the making of the old mixed metal to the preparation of pure metallic zinc.

To sum it up, the unravelling of these ancient words takes what was essentially zinc-capture back to the -2nd century. What mineral complex could have yielded mixtures of zinc and lead that could have been combined with tin to make *lien* and *la*? There are, in fact, many, for example in Australia at Broken Hill in New South Wales a sulphide ore consisting of an extremely intimate mixture of zinc blende and galena occurring on a vast scale. It is very variable in composition, the crude material containing from 10 to 20% zinc, 15 to 25% lead and a small amount of silver, in a gangue of rhodonite, garnet, quartz and calcite.^c This has been a great source of the metals in question for many years, and smaller amounts of something similar may well have been worked in China in ancient times, as they are now.^d Indeed the chief production of zinc and lead in this century and the last has been at the Shui-khou Shan⁶ mine in Hunan,^e southwest of Chhangsha—exactly the region where Ssuma Chhien said about -100 that the *lien* came from. Its ore gives about 28% zinc and 29% lead, so it is richer than Broken Hill. Another source is the Kung Shan mines in Yunnan, worked

^a The old commentators were all puzzled by this. Mêng Khang (c. +240) thought *lien* another name for tin; Li Chhi (c. +200) took it to be a name for the unsmelted ores of lead and tin; while Ying Shao (c. +190) said that *lien* was 'like copper' (as any metal would be). Yen Shih-Ku long afterwards (c. +620) averred that Mêng and Li were both wrong, and that it was some metallic substance other than tin, mixed with copper for minting. Chang I (in the *Kuang Ya* dictionary, +230, ch. 8A, p. 12a) agreed with Li that it was lead ore before smelting, another indication, perhaps, of the close association between zinc and lead in those times. The fact that the commentators of Later Han and San Kuo times did not really know what *lien* was might be due either to the fact that they were literary scholars rather than metallurgists, or to a change of terminology in the trade whereby *lien* was replaced by *la*.

Fang I-Chih in his *Thung Ya* (+1636) surmised that *lien* had been zinc, which was not wholly wrong, though at such an early date it could hardly have been metallic zinc. But one can never be sure, because isolated instances of zinc metal in early times have been reported from various parts of the world. See, for example, Farnworth, Smith & Rodda (1) on a hammered sheet of pure zinc found in -3rd-century remains at Athens (p. 198 above). The silver smelters at Laurium certainly had good calamine.

^b By Wang Chi-Tien, reported in Chang Hung-Chao (3), and (8), p. 53; cf. also Y. L. Kao (1).

^c Cf. Gowland (9), p. 372.

^d See Ong Wên-Hao (1), p. 42; Bain (1), pp. 154, 164ff.; Collins (1), pp. 99ff.; di Villa (1), pp. 81ff.; Torgashev (1), pp. 164ff.

^e See Liang (2); Wheler & Li (1); Torgashev (1), pp. 178ff.

¹ 皆用銅殺以連錫

² 漢官儀

³ 應劭

⁴ 白水真人

⁵ 鑛

⁶ 水口山

until recently by traditional methods, and smaller centres near Thêng-yüeh. We may thus not be far wrong if we visualise the regular production of alloys of zinc, lead and tin from the -2nd or -3rd century at least until the isolation of zinc in the +9th or the +10th. Ssuma Chhien's *lien* and Ting Chao's *la* had a long run, and perhaps were little different from the 'canister metal' of the eighteenth-century China tea trade. And (to make contact again with the third rail of our exposition) by the same token *lien* and *la* (as well as calamine perhaps) were available to the alchemists, certainly by Li Shao-Chün's time, conceivably by Tsou Yen's, for the making of brass as artificial gold.

As now we leave this topic and approach that of the imitation of silver by alloys of cupro-nickel and other types, it is worth while to look once again at a passage already quoted in Sect. 7, a text which records something that happened in Ssuma Chhien's own life-time.^a Talking of the people who were occupying the tracts from Ta-Yuan (Ferghana) westwards to An-Hsi (Parthia) during the second half of the -2nd century, Ssuma Chhien wrote:^b

These countries produced no silk or lacquer, nor did they know the technique of casting (*chu*¹) iron for pots and pans and all kinds of useful implements... When some deserters from the retinue of a Chinese embassy (*Han shih wang tsu*²) had settled there, however, they taught them to cast weapons (of iron) and many other useful things. And when (the people of these parts) got hold of Chinese yellow and white metal (*tê Han huang pai chin*³) they immediately used it for (casting) utensils and not for coining money.

The introduction of iron-casting into Central Asia at this time, *c.* -110, remains a focal point of interest for that subject (cf. Sect. 30), but what matters for us here is the interpretation of the last sentence. In Sect. 7 we took 'yellow and white metal' to mean gold and silver, as anyone familiar with Taoist alchemical terminology naturally would, but that was really rather too simple, and we ask ourselves now whether various alloys were not implied. One could suppose that the yellow metal (if not a much-debased low-carat gold) was a brass of some kind, or just possibly of course a medium-tin bronze. Similarly the white metal could have been a high-tin bronze like speculum metal, or, more interestingly, a cupro-nickel like the paktong we shall be discussing in the following pages, or evidently a silver greatly diluted with tin or with the Zn-Pb-Sn alloy called *lien* and *la*. One thing at any rate is certain, namely that the Chinese were surprised that the Ferghanese-Parthians used it for vessels rather than for coinage; this suggests (*a*) that the metals were among those used for minting within China, and (*b*) that the Central Asians at that time lacked a money economy in which coins would have been useful. Hence the interest of some of the analyses which have been made of coins from the Former Han period (see Table 98). Coins of -186 have as much as 25% lead, while those of -175 as much as 4% zinc. The special interest of these lies in the fact that they date from the period preceding the 'anti-coining' edict of -144 (cf. pp. 12-13) which betrays the existence of so much deceptive alloying and aurification,

^a Vol. 1, pp. 234, 235.

^b *Shih Chi*, ch. 123, p. 156, retr. auct., adjuv. Hirth (2).

¹ 鑄

² 漢使亡卒

³ 得漢黃白金

indeed a whole tradition of it. But so far the analyses have been few, and it is greatly to be hoped that more will be made. The first half of the —2nd century is a time of great importance for the history of metallurgical knowledge and practice in Chinese culture, and more light on it is urgently needed. In the meantime, one suspects that the 'yellow and white metals' which the Ferghanese-Parthians received from China were fairly complex alloys, certainly not purified gold and silver.

Having now come to the border of the brass country, one describes, on looking back, another of those curious parallelisms which have been met with before, situations where certain inventions or discoveries appear almost simultaneously at the two ends of the Old World. The inventions of the water-mill, and of rotary milling itself, are cases which spring to mind.^a Apart from the transient Homeric use of natural mixed ores of copper and zinc (if that was really what it was), brass seems to have become current during the —3rd century both in the Greek and the Chinese culture-areas. This suggests an intermediate source from which the knowledge would have spread out in both directions. The later mentions (pp. 201–2, 203 above) of brass as a Persian export would point to the Iranian culture-area as the place where we ought to look,^b but unfortunately the early history of science and technology in that region is still so poorly documented that we know of no better evidence than in the other two, equally obscure, examples.^c

^a Vol. 4, pt. 2, pp. 190, 407.

^b Southern Persia is particularly rich in zinc ores. The main deposits lie between Isfahan and Anarak in the Kūh-e Banān mountains north of Yazd; here it was that Marco Polo visited the 'tuttia' factories.

^c There is an interesting study of the brass-makers' and braziers' arts in the Persia of surviving tradition by Wulff (1), pp. 20ff., 28ff., but his historical notes (pp. 12ff.) take us no nearer the root of the problem. Forbes (3), p. 279, (28), p. 268, found the earliest Iranian reference to brass in the —8th-century Khorsabad inscriptions of Sargon II, but the 'shining' or 'white' bronze of the text is not very convincing, though it might record a momentary appearance similar to the Homeric one and slightly earlier.

The Pseudo-Aristotle book already mentioned (p. 198) attributes the best brass in the +2nd century to the Mossynoeci, a people living in the eastern part of Asia Minor, south of Trebizond in the Pontus; and Forbes, pursuing somewhat speculatively their identity and relations with Assyrians and Hebrews (3, 28, *loc. cit.*), saw this region as the oldest home of brass-making. We are not inclined to follow him in arguing back from this to the early centuries of the —1st millennium, but somewhere in the —5th or the —4th century might be a fairly safe guess.

Forbes (3), p. 283, (28), p. 273, says (giving no reference) that Zosimus was 'quite conversant with the manufacture of brass from cadmia and copper, saying that the preparation of the "yellow or Persian alloy, wholly like natural gold" . . . was an important secret invented by a mythical Pabapnidos, son of Sitos'. If he was a Persian the myth would be interesting. Although the Corpus contains several accounts of brass-making (e.g. III, xlvi; v, i, 55, xxviii) this passage is not to be found among them. Nor is it in *Corp.* v, iv, a tractate of the +8th century on brass-making 'according to the Persians'. Forbes' source must have been the +15th-century Syriac version of Zosimus' writings preserved in the Bensly Collection at Cambridge, and translated by Berthelot & Duval (1), pp. 227, 228. It is true that brass seems to be called yellow copper, white copper, or 'Persian copper' here, but what Pabapnidos did is not obvious; he may have rather been the inventor of certain coloured surface-films produced by 'bronzing dips', and if the text, which certainly has an archaic character, is to be placed near Zosimus' own time (c. +300), Pabapnidos would be yet another of the Alexandrian aurifictors or aurifactors.

All in all, nevertheless, we are disposed to favour the view that brass-making began in the Persian culture-area and spread both west to Europe and east to China. Yet hesitations remain. The Pseudo-Aristotle refers to an 'Indian' cup in Persia that looked like gold but had a disagreeable smell—very suspicious of brass—saying that it was in the possession of Darius (presumably the First, —521 to —485). The date and the owner might be wrong, but the place might be right. And 'India' can always be 'Further India', i.e. East Asia. So the question of Persian origin still remains open.

(iii) *Other golden alloys*

Lastly there is a group of artificial golds which cannot reasonably be considered brasses. Some typical compositions are assembled in Table 99, with marginal notes on their qualities.^a Half-a-dozen of them can be ruled out of court for ancient and medieval China because of the presence of platinum;^b and the same would be true of ancient and medieval Europe where also there was no use or knowledge of this metal until modern times. Only in the southern Amerindian cultures was platinum worked, and we should not lose this opportunity of giving to them the credit they deserve.^c This does not mean that the Peruvian, Colombian and Ecuadorian Indian metal-workers ever smelted platinum or melted it, for it fuses only at a relatively high temperature (1773° C.);^d but they were able to sinter it with the blowpipe on charcoal,^e thus preparing alloys with gold, silver and copper containing up to 57% platinum.^f Objects of gold, or gold and copper,^g were then sometimes plated with this silvery metal.^h Platinum deposits later caused difficulties for the Spanish miners. In +1557 Scaliger wrote that there was a kind of brass found in Mexico which no fire or arts of the Spaniards could liquefy, and Antonio de Ulloa the mathematician, who visited that country in +1735, reported that several mines had been abandoned because of the 'platina' which defied all efforts to work it. Native platinum was brought to Europe

^a Ref. Hiorns (2), pp. 274, 423, 426, 451; Hiscox (1), pp. 50, 67, 74.

^b Nevertheless, native platinum has been reported as found with placer gold in Shantung and elsewhere (Torgashev (1), p. 266), so it may conceivably have got into the hands of Chinese goldsmiths and alchemists in medieval times.

^c Cf. Vol. 4, pt. 3, p. 544. The discovery that some of the Amerindian cultures had systematically worked platinum was first made in 1879 by T. Wolf (1), who found 18% Pt in some of the *electrum* objects, white with a yellowish-grey tinge. Since then much metallurgical work has followed. Perhaps the best account is that of Bergsøe (1); but cf. also Saville (1); Farabee (1, 2); Rivet (2, 3); Rivet & Arsendaux (1); Covarrubias (2), pp. 126 ff.

^d For comparison: Cu 1083°, Au 1063°, Ag 960°, Pb 327°. Compare also pure wrought iron 1535°, steel with c. 1% C, 1470°, and cast iron with 4.3% C, 1130°.

^e Their starting material was undoubtedly grains of native platinum separated by hand from the particles of native gold panned in the rivers of the Esmeraldas coast of Ecuador. When the two metals are heated together on charcoal under the blowpipe the platinum becomes pasty and dissolves in the molten gold. A similar technique has been used in modern times for making alloys of tungsten. W does not melt under 3390°, but an equal mixture of copper and nickel on the point of fusing at 1450° will dissolve no less than nine times its own weight of tungsten (Smithells, 1).

^f The objects which were made with these, always by forging and cold-hammering, never casting, are harder than the best bronze and much harder than wrought iron. Minute objects of exquisite delicacy made with tiny gold or gold alloy grains or balls and very thin wires were soldered together by the use of copper hydroxide and gum; after heating to about 1000° the gold surfaces, containing very little copper, become firmly but invisibly cemented together. As the heating increases the process passes through successive stages of oxidation, carbonisation, reduction, and alloying by diffusion. It was almost certainly used in Europe also as early as the 8th century, e.g. by the Etruscans, later occasionally, then rediscovered by H. A. P. Littlefield in 1934. See the description in Bergsøe (2), pp. 50 ff., as also Maryon (3, 4, 5) and Singer (24). All this gives us the explanation for the meaning of the sometimes mysterious references to 'chrysocolle' in Pliny (esp. *Nat. Hist.* xxxiii, xxvi to xxx, 86-94, tr. & comm. Bailey (1), vol. 1, pp. 105 ff., 205 ff.) and in the Alexandrian Corpus (cf. Berthelot (1), p. 222, (2), p. 232). See also C. S. Smith (7), p. 100.

^g It is sure that up to 50% copper was purposely added, but the silver (up to 23%) never exceeds the proportion in native *electrum*. The platinum contains up to 3% iridium, and of course smaller amounts of the related metals.

^h Details in Bergsøe (1).

Table 99. *Other gold-like alloys (percentage compositions)*

	Ag	Cu	Sn	Zn	Pb	Fe	Al	Ni	Mg	Pt	Sb	As	colour and properties
arsenical copper	—	98	—	—	—	—	—	—	—	—	—	2	cf. Table 102, p. 240 very golden if polished after treatment with nitric acid
'non-oxidisable gold'	—	94·8	—	2·8	0·7	1·4	—	—	—	—	—	—	
German gold	—	94·5	—	—	—	—	—	—	—	—	5·5	—	for the purple or violet alloy of equal proportions (Regulus of Venus) see p. 267
'imitation gold' {	—	83	11·5	—	—	—	—	—	5	—	—	—	} fine-grained, highly malleable and polishable
	—	83	—	11·5	—	—	—	—	5	—	—	—	
Cooper's gold	—	81·25	—	—	—	—	—	—	—	18·75	—	—	very like 18-carat gold
aluminium bronze gold	—	80	1-10	—	—	—	1-10	—	—	—	—	—	golden, cf. aluminium bronze in Table 97
platinor	10	59·5	—	3·5	—	—	—	9	—	18	—	—	golden
Cooper's mirror metal	—	58	27·5	3·5	—	—	—	—	—	9·5	—	1·7	resistant to oxidation, highly polishable yellow, specific gravity similar to gold pale yellow, hard, corrosion-resistant, good for bearings of precision instruments
'imitation gold'	9	57	—	6	—	—	—	9	—	18	—	—	
Clarke's alloy	—	50	—	—	—	—	—	—	—	50	—	—	
Cooper's pen metal	36·5	13·5	—	—	—	—	—	—	—	50	—	—	

by C. Wood in +1741, and finally recognised as a 'new' metal by Theophilus Scheffer in +1752.^a

But leaving platinum on one side, other alloys in Table 99 would have been quite possible for the medieval Chinese alchemists. The so-called 'non-oxidisable gold', which contains a little iron, would probably have been a feasible option for them. This complex alloy recalls the *claudianum* of the Romans, though that had tin and arsenic instead of iron,^b as did the *molybdochalcum* of the Alexandrians,^c mixtures to which no combination of metals in modern use seems to correspond. Also possible, in our view, would have been the 'German' gold which uses about 5% antimony, for stibnite could perhaps have taken the place of calamine. Then there are the 'bronzes' and 'brasses' containing some 5% magnesium; if any alchemist could have found conditions such that magnesite could replace calamine or stibnite, he might perhaps have produced some interesting artificial golds of this kind.^d Aluminium bronze gold remains a question-mark, for reasons already given.^e Finally, an alloy of 67.5% silver with 32.5% zinc has a faintly reddish-yellow surface tinge, and after about +900 that too would have been easily possible.^f In this connection one should also remember that in the simple debasement of silver with copper, the colour remains white until the latter reaches some 50%, after which it is yellowish until 70%, then distinctly red. In certain conditions, therefore, a gold-like alloy could be obtained with silver and copper alone.^g

(3) ARSENICAL COPPER

This is the point at which we have to leave the realm of gold-glittering things and enter that of the silvery ones. There is no better way of making this transition than by considering copper and bronzes containing arsenic, for the remarkable fact is that 2% of arsenic can confer upon copper a beautiful golden colour, while 4.6% makes it shine and glow like silver;^h proportions higher than 8.0 to 9.5% will not combine homogeneously at all, and above 6% the metal is a dull white. In view of the relatively small additions of arsenic (as sulphides or oxides) necessary to bring about these effects, and presuming that the alchemists used appropriate means to prevent its loss by volatilisation, one can see at once yet another process by which both aurifaction and argentifaction by 'projection' could have been carried on, indeed as far back in Chinese history as one likes to go—the time of Tsou Yen in the —4th century for example.

This is one of those rare cases where we need not have undue fear of too precocious datings, for archaeologists in recent years have discovered objects of copper and bronze high in arsenic from many ancient cultures.ⁱ The Aegean Early Bronze Age 2

^a Partington (7), vol. 3, p. 176. Eventually it led to the first real success in powder metallurgy, when W. H. Wollaston of Caius in 1804 prepared malleable platinum (*ibid.* p. 698). Cf. Sivin (6); McDonald (1).

^b Berthelot (2), pp. 67, 70, 71. Cf. p. 195 above.

^c Berthelot, *loc. cit.*; Hopkins (1), pp. 103 ff., 106 ff.

^d Cf. p. 191 above.

^e Cf. p. 192 above.

^f Hiorns (2), p. 396.

^g Hiorns (2), pp. 399 ff.

^h Private communication from Mr J. A. Charles. Cf. Table 102; and Berthelot (2), pp. 34, 60, 62, 68; Sherwood Taylor (2), pp. 125 ff. Tensile strength is already increased at 0.1 to 0.5% As.

ⁱ For a brief but valuable survey of the earliest metallurgy see Wertime (1).

and Middle Bronze Age periods, for instance (c. -2500 to -1500), have yielded hundreds of tools and weapons containing up to 8.8% tin and 9.5% arsenic, the highest figures for the one tending to correspond with the lowest figures for the other.^a After much uncertainty, Charles (1) has brought forward convincing arguments in support of the view that the arsenic was added intentionally, not occurring merely as the result of using mixed ores,^b for their reduction would inevitably have driven it off. Random mineral selection could never give as much as 8% arsenic in copper, and it is much more reasonable to visualise the ancient craftsmen adding well-chosen amounts of blackish enargite or yellow orpiment or realgar. What they did it for, apart from scarcity of tin (which may have been a factor in the Aegean), appears by the properties of the resulting alloy; for arsenic is a strong deoxidising agent, and by minimising the amount of copper oxide formed in the metal makes it much more ductile and workable, whether cold or hot. Besides being more easily forged the eventual alloy is harder than ordinary copper or bronze, yet not brittle.^c Charles concludes that the 'arsenical phase' of Bronze Age metallurgy came to an end whenever tin became available in plenty, simply because of the extreme risk of poisoning by arsenic, especially under primitive working conditions. All this shows that we have to do here with a very ancient technique, common probably to the whole of the Old World,^d and one which is an inescapable part of the background of later aurifaction and aurification both in East and West.

What the Bronze Age smiths had done to get daggers and axes of good quality, not much caring about the colour, was revived, perhaps, by the metallurgical experimenters of the late -1st millennium, precisely because of the interest of the alloy colours. We know how impressed the Alexandrian proto-chemists were with the surface colour effects produced by arsenical vapours on copper, effects which they probably learnt to control with some delicacy (p. 252 below),^e and there is every reason to think it likely, from the prominence of orpiment and realgar in the oldest data we have on Chinese proto-chemistry,^f that the Chinese incorporated arsenic in copper and bronze to get artificial gold and silver. This would be a further explanation of the early -2nd-century coining aurification (p. 12), as also of the later -2nd-century aurifaction of Li Shao-Chün (p. 13). Such an alternative to brass must also be taken into account in evaluating the oldest possible references to that alloy, and we had better leave open the possibility that the Homeric and Persian *oreichalkos* was in fact arsenical copper

^a Cf. Caley (3); Renfrew (1); as also Selimkhanov (1) for the Caucasus and Coghlan (6) for Europe, including ancient Ireland.

^b E.g. enargite (Cu_3AsS_4) and tennantite ($\text{Cu}_{12}\text{As}_4\text{S}_{13}$).

^c Arsenical copper is still used today for certain special purposes such as boiler firebox components, because of its high strength retention at moderate temperatures after cold working.

^d Chinese antiquity remains to be investigated in this respect, but there does not seem to be much arsenic in Shang bronzes (Pope, Gettens *et al.* 1). Probably tin was quite plentiful in China. Conceivably the arrival of knowledge of the ancient arsenic technique was a factor in the beginnings of aurification there.

^e There is a rather clear account of the making of golden arsenical copper in a text of Olympiodorus (c. +500); *Corp. Alchem. Gr.* II, iv, 12.

^f They are both in the *Shen Nung Pên Tshao Ching*, which is evidence for the -2nd century and strong presumption for the -4th or earlier.

or bronze. In this case we must hope that Darius did not drink too deeply out of his cup.^a

Textual evidence fully bears out these conclusions. Thao Hung-Ching is quoted as saying (probably in his *Pên Tshao Ching Chi Chu*) about +500, that realgar (*hsiung huang*¹) can be used to turn copper into gold.^b The *Pao Tsang Lun*, datable at +918, states even more precisely, and correctly, that the middle quality of realgar can be used to turn copper into 'gold' by projection (*tien*²).^c And the main text of the *Chêng Lei Pên Tshao* (+1108) reaffirms that this sulphide of arsenic can be used to make gold from copper (*tê thung kho tso chin*³).^d In view of the antiquity of this discovery, Han references would be quite possible and should be sought for.

(4) SILVERY UNIFORM-SUBSTRATE ALLOYS

Silver itself can be 'debased' or diluted just as gold can, and it shares with gold to some extent the property of giving an appearance similar to that of the pure metal even when combined with relatively large amounts of other metal. Table 100 gives a perspective for a number of silver-containing alloys,^e most of which could have been made by medieval Chinese alchemists with the doubtful exception of those containing aluminium. An equal mixture of silver and copper with a little arsenic used to be employed in the West, strangely enough, for tableware, and all the nickel-containing alloys, essentially paktongs with small amounts of silver present, could have been produced in China. Two of these, indeed, each containing only 2% of the precious metal, and one including some cobalt, go by the name of 'Chinese silver' or 'China silver' in modern European manuals, but we have not been able to trace their origin or how they came by these names. One of them is a bronze, with 19.5% tin, and a similar alloy without the nickel was, it seems, much used for coins in medieval Persia. The silver-zinc combination, too, would have presented little difficulty in China after the beginning of the +10th century. More interesting, perhaps, were the Chinese artificial silvers which contained, like the cupro-nickel coins in our pockets, no silver at all.

(i) *Paktong* ('*Tanyang copper*', *cupro-nickel*)

On polished Restoration period dinner-tables there stood elegant candlesticks, and eighteenth-century hearths were resplendent with fire-grates, of an attractive corrosion-resistant silvery metal which people called 'paktong'^f or (wrongly) *tutenag* or 'tooth-and-egg' metal;^g but if one inquired what this 'white copper' was they could only reply, in spite of all that the new science of chemistry was doing, that it was an import

^a P. 220 above.

^b *CLPT*, ch. 4, (p. 101.1). The details, he adds, can be found in the books on alchemy (*huang pai shu*⁴).

^c *CLPT*, ch. 4, (p. 102.2).

^d *CLPT*, ch. 4, (p. 101.1).

^e Ref. Hiorns (2), pp. 305, 396, 399, 406, 413, 423; Hiscox (1), pp. 50, 64, 74, 75, 76; Wulff (1), p. 14.

^f By an error of transcription which long persisted, the word was often spelt 'pakfong'.

^g Cf. p. 212 above.

¹ 雄黃

點

³ 得銅可作金

⁴ 黃白術

Table 100. *Diluted or 'debased' silvers (percentage compositions)*

	Au	Ag	Cu	Sn	Zn	Mn	Fe	Al	Ni	Co	As	Pt	
Levol's alloy	—	71.9	28.1	—	—	—	—	—	—	—	—	—	the only non-segregating double alloy
Smith-Berthier alloy	—	81.5	—	—	—	—	—	—	—	—	18.5	—	} like burnished silver, formerly used for tableware
arsenical silver	—	49	49	—	—	—	—	—	—	—	2	—	
Japanese 'grey silver' <i>shibu-ichi</i>	0.1	40	59.4	—	—	—	0.5	—	—	—	—	—	cf. Table 96 and pp. 264-5
Abel metals	{	33	40	—	—	—	—	—	27	—	—	—	for jewellery
silver-zinc	—	33	42	—	16	—	—	—	9	—	—	—	essentially a paktong with silver
tiers-argent	—	33	—	—	66	—	—	—	—	—	—	—	quite like silver
Mousset's metal	—	33	—	—	—	—	—	66	—	—	—	—	for silvery utensils and solder
	—	27.5	59.5	—	9.5	—	—	—	3.5	—	—	—	reddish-yellow tint but fracture white
argent-Ruolz	{	20-30	35-50	—	—	—	—	—	25-30	—	—	—	} close resemblance to silver, better for casting if a little P added
	—	20	50	—	—	—	—	—	30	—	—	—	
	—	14	50	—	—	—	—	—	36	—	—	—	
Swiss coinage alloy	—	10	55	—	10	—	—	—	25	—	—	—	a paktong with a little silver, goes yellow like poor brass
Kermān silver bronze	—	10	74	16	—	—	—	—	—	—	—	—	used for coins in + 12th-century Persia
aluminium-silver	—	3	—	—	—	—	—	97	—	—	—	—	handsomely silvery
'Chinese silver'	—	2	58	—	17.5	—	—	—	11.5	11	—	—	} 'imitation silver', cf. paktong
'China silver'	—	2	65	19.5	—	—	—	—	13	—	—	—	
American nickel silver	—	1.2	58	1.2	21.5	2.4	0.6	—	14.5	—	—	—	for artificial jewellery

from the Chinese, carried hither in the ships of the Honourable East India Company. Indeed it was true that the export of *pai thung*¹ (white copper) to the West had started early in the +17th century. Perhaps the oldest European reference to it occurs in the writings of the great instaurator of chemistry, Andreas Libavius. In his *Alchemia* of +1597 *aes album* had meant only copper surface-whitened by mercury or silver,^a but in the *De Natura Metallorum*, one of the tracts contained in his *Singularium*... pt. 1, printed in +1599, the same term was applied to a new metal from the East Indies, 'not zinc but a special kind of sonorous tin', hence its Spanish name 'tintinaso'.^b Although it soon became clear that paktong was neither zinc nor tin, understanding of its nature came only very slowly. Among the many mentions of it^c one finds, on opening the 'Grand Dictionnaire Historique' of Morery (+1688) at the words China (Chekiang): 'On tire aussi dans la Chine quantité de minéraux, comme du vif-argent, du vermillon, de la pierre d'azur et du vitriol. On y fait du cuivre blanc, qui n'est gueres plus cher que le jaune...' ^d But what it really was, the lexicographer was not prepared to disclose. A century later the chemical bishop, Richard Watson of Cambridge, discussed it in his 'Chemical Essays'.^e After speaking of the ancient idea, common, as we have seen, to East and West, that there were two sorts of brass or *orichalcum*, one made from natural mixed ore and the other by the addition of calamine, he goes on to say:

In du Halde's 'History of China'^f we meet with the following account of the Chinese white copper: 'The most extraordinary copper is called *pe-tong*, or white copper: it is white when dug out of the mine, and still more white within than without. It appears, by a vast number of experiments made at Peking, that its colour is owing to no mixture;^g on the contrary all mixtures diminish its beauty; for, when it is rightly managed, it looks exactly like silver, and were there not a necessity of mixing a little *tutenag*, or some such metal with it, to soften it, and prevent its brittleness, it would be so much the more extraordinary, as this sort of copper is, perhaps, to be met with no where but in China, and that only in the province of Yunnan.'

Notwithstanding what is here said, of the colour of this copper being owing to no mixture, it is certain that the Chinese white copper, as brought to us, is a mixt metal; so that the ore from which it is extracted must consist of various metallic substances; and from some such ore it is possible that the natural *orichalcum*, if ever it existed, may have been made.

Thus Watson realised, as du Halde had not, that paktong was an alloy of at least three main constituent metals.^h A little later he muses on the vagueness of ancient authors and the incuriousness of men.ⁱ

^a Rex ed., p. 173.

^b This term must surely have been a confusion between *tintinnare* and *tutenag*.

^c See the special monographs by Bonnin (1) and Howard-White (1).

^d 9th ed. (+1702), p. 154. The English translation of the previous year was due to Jeremy Collier of Caius.

^e (1), vol. 4, pp. 108ff. (+1786).

^f Published in +1735, Eng. tr., +1736, vol. 1, p. 16.

^g This does not say much for the chemical ability of du Halde's Jesuit contemporaries in China.

^h He also distinguished (vol. 4, p. 28) the two uses of the word *tutenag* (zinc and paktong), and differentiated clearly (vol. 5, p. 251) between white arsenical copper and paktong.

ⁱ (1), vol. 4, pp. 116ff.

¹ 白銅

The compass [he writes] enables us to extend our researches to every quarter of the globe with the greatest ease; and an historical narration of what is seen in distant countries is now infinitely more diffused than it could have been before the invention of printing; yet even with these advantages, we are, in a great measure, strangers to the natural history of the earth, and the civil history of the nations which inhabit it. He who imports *tutenag* from the East Indies, or white copper from China or Japan, is sure of meeting with a ready market for his merchandise in Europe, without being asked any questions concerning the manner how, or the place where, they are prepared. An ingenious manufacturer of these metallic substances might wish, probably, to acquire some information about them, in order to attempt a domestic imitation of them; but the merchant who imports them seems to be too little interested in the success of his [the manufacturer's] endeavours, to take much pains in procuring for him the requisite information. Imitations, however, have been made of them, and we have an European *tutenag*, and an European white copper,^a differing, in some qualities, from those which are brought from Asia, but resembling them in so many other, that they have acquired their names. Something of this kind may have been the case with respect to *orichalcum*, and the most ancient Greeks may have known no more of the manner in which it was made, than we do of that in which the Chinese prepare their white copper; they [the Greeks] may have had too an imitation of the original, and their authors may have often mistaken the one for the other, and thus have introduced an uncertainty and confusion into their accounts of it.

In fact the whole secret had been revealed ten years before Watson's volume was published, when von Engeström (1) reported his analysis of a *paktong* ingot. It proved to consist of almost equal amounts of copper and zinc, fundamentally modified by 15.6% of nickel; presumably the *Proceedings of the Swedish Academy* were not much read in Cambridge at the time. The period between +1750 and 1800 was perhaps that of the maximum intensity of the importation, and analyses of metal from English-made candlesticks of this time by Peat and Cookson are given (together with that of von Engeström) in Table 101.^b The darkest sort proved to contain 7.7% nickel, and the lightest, said to be indistinguishable from silver, with a characteristic clear bell-like resonance when struck, and considerable resistance to corrosion, 11.1%. Another trial, by Fyfe (1) in 1822, gave as much as 31.6% nickel,^c and from him we learn that Dr Dinwiddie of the Macartney Embassy of +1793 had brought back some of the ore from which *paktong* was made.^d Cupro-nickel, as it was now understood to be,^e was first openly made by E. Thomason, who submitted his process to the consideration of

^a Here Watson has a footnote saying that 'the ingenious Dr Higgins' (presumably Bryan Higgins, +1737 to 1818) had recently received a gold medal from the Society for the Encouragement of Arts, etc., for 'white copper, made with English materials, in imitation of that brought from the East Indies', but that he had not yet made public his process. It may well have involved the use of nickel, which had been isolated only in +1751 by A. F. Cronstedt from the mixture of sulphides (*matte*) separated from cobalt ores in the traditional process for making 'smalt', the pigment cobalt-blue (Sherwood Taylor (4), pp. 87, 195; Howard-White (1), pp. 23 ff.). Nickel got its name from *kupfernickel*, the old miners' term for nickel arsenide ore, meaning spurious or 'trickster' copper, on account of its reddish colour, and recognised by Agricola as dangerous for miners and smelters (Hoover & Hoover tr., pp. 111, 214).

^b Ref. Hiorns (2), pp. 303 ff., 311, 317, 318, 457; Hiscox (1), pp. 69 ff.; Gowland (9), p. 421.

^c Gadolin (1) in 1827 got from 23 to 25%.

^d He will be remembered from Vol. 4, pt. 2, p. 475, and we shall meet him again in Vol. 6.

^e Strictly, a nickel-brass. As C. S. Smith (5) has said, *paktong* takes its place with porcelain and Damascus steel among the valuable 'oriental stimuli' for the development of a science of materials in the European eighteenth century.

the (Royal) Society of Arts (as it was now called) in 1823, but after examination they decided that it was not new, and took no further interest in it. Just at the same time the Verein zur Beförderung des Gewerbefleißes in Prussia offered a prize for a process of this kind (see Schubarth, 1), and so it was left to a number of German metallurgists, notably E. A. Geitner and J. R. von Gersdorff, to launch the 'argentan' or German silver which became thenceforward so widespread a product of the European non-ferrous metals industry.^a Since then cupro-nickel has been and continues to be used in many countries for the coinage, or as Monel metal and constantan for electrical resistances, and (with Zn) for the ubiquitous electroplated restaurant 'silver'-ware. It is interesting to reflect that when it was first made, nearly a couple of millennia ago perhaps, by the Chinese alchemists, they might well have claimed that it was positively superior to silver, since it would never tarnish by the formation of black sulphide films (cf. p. 68 above).

But how far back did it go in China? In order to answer this question we can best do what we did in the case of zinc and brass, namely start with the more recent references and work back to the earliest ones. In the late Ming and Chhing literature there is surprisingly little about paktong, though adequate accounts of the industry undoubtedly exist, and will in course of time be found, in the local topographical histories. However, one particularly important passage relevant occurs in the *Thien Kung Khai Wu* (+1637) and it is appropriate to give it here, for it has reference both backward to earlier parts of this sub-section and forward to what must be spoken of later.^b It runs as follows:

When *lu kan shih*¹ (zinc carbonate, calamine) or *wo chhien*² (zinc metal) is mixed and combined (with copper, *chhih thung*³) one gets 'yellow bronze' (i.e. ordinary brass). When *phi shuang*⁴ and other arsenical chemicals^c are heated with it, one gets 'white bronze' or 'white copper' (*pai thung*,⁵ i.e. paktong). When alum and nitre and other chemicals are heated with it one gets 'green bronze' (*chhing thung*⁶). When tin from Kuang-(tung and Kuangsi) is mixed and

^a Cf. Stanley (1); Howard-White (1), pp. 44ff. He lists (p. 273) no less than sixty-seven other trade names for alloys of this kind with slightly varying composition. There was for many years a tendency to reduce the nickel as much as possible on account of the cost, and modern Chinese paktong runs at about 6% nickel. This may be the place to remark that although we here consider cupro-nickel primarily as an 'artificial silver', the presence of nickel in amounts between 1 and 4% can confer a quasi-golden colour on the alloy. There is therefore a distinct analogy with arsenic (p. 223 above), which at low concentrations gives a golden alloy with copper and at higher ones a silvery alloy.

^b Ch. 14, p. 6b. We diverge somewhat from the interpretation of Sun & Sun (1), pp. 242, 258, both in their translation and their note.

^c *Phi* or *phi shih*⁷ is strictly arsenious trioxide (As_2O_3), found as a native mineral at Hsinchou in eastern Chiangsi (mod. Kuanghsin or Shang-jao) and hence long called *Hsin shih*⁸ (RP 91). *Hung hsin shih*⁹ or red Hsinchow arsenic is a mixture of the arsenic oxide with realgar (RP 91). Natural arsenolite (*yü shih*¹⁰), a different mineral, also long exploited in China (RP 88), is approximately the same thing chemically as *phi shih*. Both terms tend to occur in connection with paktong because the nickel used was often in the form of either kupfernickel (NiAs), *hung thung*¹¹ (RP 6), or nickel glance (NiAsS), and the dangerous arsenical vapours were well recognised. See also Torgashev (1), pp. 253, 284. From Gowland (9), p. 458, arsenical oxide minerals have not apparently been economically important in other parts of the world.

¹ 爐甘石

² 倭鉛

³ 赤銅

⁴ 砒霜

⁵ 白銅

⁶ 青銅

⁷ 砒石

⁸ 信石

⁹ 紅信石

¹⁰ 礬石

¹¹ 紅銅

combined with it one gets 'resonant bronze' (*hsiang thung*,¹ i.e. the classical bronze). And when *wo chhien*² is combined with it, it flows out as 'best casting bronze' (*chu thung*,³ i.e. casting brass).

Thus we have a clear statement concerning bronze, two sorts of brass, and paktong. The third sentence we believe refers not to a melt at all but to a 'bronzing dip' for brass, intended to give it the colour or patina imitative of ancient bronze. This belongs to the field of surface layers and finishes, and we shall return to it on p. 265 below. Li Shih-Chen in +1596 also has a bare mention of paktong in essentially the same terms.^a

Prior to the words of Sung and Li there is a long gap, though the industry must have been continually at work, probably buried away from most people's knowledge in Yunnan. When we do meet with the words *pai thung*⁴ again they occur as one of the imports shipped to China in the early +13th century from the island of Kish in the Persian gulf.^b Hirth & Rockhill translated Chao Ju-Kua's phrase of +1225 as 'spelter' but the product is extremely unlikely to have been zinc metal,^c and one would think rather of arsenical copper or vessels plated with tin, silver or arsenic; unless indeed it was Chinese cupro-nickel fabricated into objects and coming home. Next comes a particularly interesting account of the making of a white metal from copper in the *Chhun Chu Chi Wên*⁵ (Record of Things heard at Spring Island) written by Ho Wei⁶ about +1095, but we shall reserve it for a moment until we have cleared up the probable antiquity of the paktong industry. *Pai thung* occurs again, not only in the *Ko Wu Tshu Than* of +980 already quoted (p. 199 above), but also in the *Chiu Thang Shu* (+945) as the metal of certain valuable ornaments in the chapter on imperial vehicles.^d Before that we can be carried back a good few centuries by extant coins of paktong dating from the Khai-Yuan reign-period (+713 to +742) of the Tang dynasty,^e the year +585 (in the Sui),^f and the period +419 to +425 when they were used by the Hunnish Hsia kingdom of Holien Pho-Pho.^g These, with one outstanding exception shortly to be remarked upon, must surely be among the oldest cupro-nickel mintings anywhere in the world (Fig. 1324).^h Meanwhile, about +640, Sun Ssu-Mo gave methods for 'doubling' or augmenting *pai thung* in his *Tan Ching Yao Chüeh*.ⁱ Not quite a century before Holien's time comes the mention in the *Hua Yang Kuo Chih*,⁷

^a PTKM, ch. 8, (p. 8).

^b *Chu Fan Chih*, ch. 1, p. 27b.

^c (1), p. 134.

^d Ch. 45, p. 4a.

^e A piece of evidence for paktong coins in the Tang has survived in the dynastic history. The *Hsin Thang Shu*, in one of its economics chapters (ch. 54, pp. 7b, 8a), says: 'The commissioner of Inland Revenue, Chao Tsan,⁸ collected white copper (*pai thung*) from Lienchow, and with it cast large coins.' This was in the close neighbourhood of +780. The passage was noted by Chang Hung-Chao (8), p. 103.

^f The *Hsin Thang Shu* also remarks on the use of 'white money' (*pai chhien*) towards the end of the Sui (ch. 54, p. 4b).

^g We have encountered this potentate already in several technological contexts, e.g. Vol. 4, pt. 2, pp. 38, 219, and Vol. 4, pt. 3, p. 42. We meet him again in Vol. 5, pt. 1 (Sect. 30).

^h Knowledge of these coins we owe to a private communication from Dr Sung Ta-Jen of Shanghai (Dec. 1963). They seem to be rare, so we hope they will be submitted to spectrographic analysis.

ⁱ On this see Vol. 5, pt. 3 below. He added lead in the form of the basic carbonate.

¹ 鑄銅

² 倭鉛

³ 鑄銅

⁴ 白銅

⁵ 春渚紀聞

⁶ 何遜

⁷ 華陽國志

⁸ 趙贊

⁹ 白錢

that study in the human geography of West China which Chhang Chhü¹ wrote in +347; he says that paktong is produced from a certain range called Thang-lang Shan² (Praying-Mantis Mountain) in a *hsien* of the same name in Yunnan province.³ Lastly, we reach the nub or focal point of the whole question in the blunt statement of Chang I's⁴ *Kuang Ya*⁵ dictionary of +230 that '*wu*⁶ is *pai thung*'.^b

This puts the cat among the historical pigeons, as it were, for the word *wu* occurs already in one of the *Shih Ching* odes, a folk-song which may be dated to the beginning of the -8th century if not rather earlier.^c A girl is singing the praises of her lover or husband and his glittering war-chariot, and each verse contains the adjective *wu*⁵ applied successively to harness-rings, rein-buckles and spear butt-caps. Everyone is naturally reluctant to put cupro-nickel back as far as this, and after much uncertainty the matter has been judiciously elucidated by Chang Tzu-Kao (4). Legge translated simply 'gilt',^d but cannier Karlgren and Waley chose 'silvered', knowing what traditions the commentators had preserved.^e As Chang pointed out, the word *tu*⁶ for gilding or silvering is not in the *Shuo Wen* but came in during the Liu Chhao period, for the *Thang Liu Tien* of +739 includes it among its fourteen kinds of gold (cf. p. 274). The gilding of bronze is now called *liu*,⁷ a word of obvious semantic significance since *liu*⁸ means to flow or flood over, suggesting amalgamation gilding. The *Chi Yün* dictionary of +1037 is the first to explain this properly, though the *Kuang Yün* (+543)

^a Near modern Tung-chuan⁹ in northern Yunnan south-east of the Yangtze. It is interesting to verify this by modern sources, and indeed we find that in von Richthofen's time (6), p. 136 (1870-2), the main centre of nickel production was at Hui-li Chou¹⁰ (mod. Hui-tsé¹¹) in Szechuan (at one time Sikang), not far away across the Yangtze to the north-west (cf. Collins (1), p. 241). This part of the Upper Yangtze valley sent out the cupro-nickel to other provinces in the form of round or lenticular cakes, which were then used to alloy with copper, zinc, tin and lead in all desired proportions for making water tobacco-pipes, tea and wine pots, plates, candlesticks, incense-burners and the like. We have an analysis of one of the Hui-li pigs by Levol (1), who found it to contain 79.4 % Cu, 16 % Ni and 4.6 % Fe. Zinc was doubtless added in the workshops to improve malleability and whiten the alloy further. There are, however, many other deposits of nickel ore in China, e.g. in Shensi (di Villa (1), pp. 34ff.), and two other places in Yunnan (Chang Tzu-Kung, 1).

It will have been clear from the foregoing pages that when early Chinese texts speak of adding 'arsenic' to get 'white copper' one has to assume, at least in many cases, that nickel arsenide was meant. Wang Chin (6), in (2), p. 91, was perhaps the first to see this, and Chang Tzu-Kung (1) assumes it. Thus for the sake of simplification we have supposed that the Chinese nickel ores used through the centuries, especially by the alchemists, were mostly kupfernickel (NiAs) and nickel glance (NiAsS); but in fact it seems (from the older literature reviewed in Chêng & Schwitter, 1) that the most important Yunnanese and Szechuanese deposits, much used in later times, were largely pentlandite (NiFeS) occurring with chalcopyrite (CuFeS₂). What Torgashev says, (1), p. 253, supports this. These nickel-copper sulphides must have been smelted at very low temperatures so that they did not fuse, permitting the complete removal of the sulphur, and the production of mixed oxides which could readily be reduced to the mixed metals. This secret was exactly that rediscovered in 1905 by R. C. Stanley when he first prepared Monel metal (Table 101) from the mixed sulphide deposits at Sudbury in Canada. At what date it was mastered in China remains to be found out, but it must have been at some early time because of the *Hua Yang Kuo Chih* reference to the Yunnanese sources.

It is now thought that the remarkable deposits at Sudbury may be an astrobleme deriving from the fall of an asteroid some three or four miles in diameter (Ruddy, 1).

^b Ch. 8A, p. 11b.

^c 1, xi, 3; Mao no. 128.

^d (8), vol. 1, pp. 193, 194.

^e (14), p. 82, and (1), p. 111 respectively.

¹ 常璩

² 螭螂山

³ 張揖

⁴ 廣雅

⁵ 鑒

⁶ 鍍

⁷ 流

⁸ 流

⁹ 東川

¹⁰ 會理州

¹¹ 會澤

lists it simply as 'beautifully golden',^a and there is a poem of Li Shen's¹ some time about +830 which says: 'false gold can be gilded (*liu*²) with real gold, but real gold needs no gilding.' Now *wu*³ is a parallel case to these. Chêng's commentary on the 'Book of Odes' joins with the *Shih Ming* (+100), the *Shuo Wên* (+121) and the *Kuang Yün* (+543) in defining it simply as 'white metal' or 'whitened metal' rather than 'white copper' or 'white bronze', but Khung's commentary explains that it is metal washed (*wu*⁴) white and bright so that it shines like ricefields under the sun.^b These unusual words for washing (like *wu*⁵) are considered onomatopoeic. One cannot positively exclude silvering for all this chariot-gear, but a temperature of some 960° C. would have been needed for it, and tinning needs only 230°. Moreover, in those early times silver was generally used for inlaying, while tinned bronze vessels of the Shang and Chou are quite well known.^c Tinning is also strongly indicated by Khung's further suggestion that the *Shih Ching* ornaments could have been 'white iron' (*pai thieh*⁶) as well as 'white bronze'.^d The process simply involves dipping in molten tin after a prior cleaning of the metal surface with sal ammoniac; it was fairly common also in Western antiquity and the Middle Ages.^e Perhaps then Chang I in the +3rd century explained an old surface-layer word, *wu*, in terms of a fairly new alloy, paktong. Chang Tzu-Kung (1) has suggested that the making of cupro-nickel started in the Han, probably after the subjection of northern Yunnan by Han Wu Ti about -130, when the deposits of arsenical nickel became more generally known; so the most likely interpretation is that Chang I did not himself clearly distinguish between tinned bronze or iron and paktong.^f It would take a special research to follow the word *wu* in later literature, but it seems to have died out in or before the Tang.

This being established we can return to the passage already mentioned from the *Chhun Chu Chi Wên* of c. +1095, which has interesting ramifications. What Ho Wei wrote was as follows:^g

The Tan-yang transmutation of copper (*Tan-yang hua thung*⁷).

Hsüeh Tho,⁸ a man from Lan-ling,⁹ once received from a certain strange person a method of making and using refined arsenical powder (*tuan phi fên*¹⁰). It was called the Tanyang process.

I remember on one occasion I followed my teacher Wei-Chan¹¹ when he went to visit him, and I asked for his reagent. Whereupon he took out a tenth of an ounce or so, using a piece of paper as a spatula, and said to me: 'This is as good as enough food for me to cultivate the

^a Ch. 2, p. 51a.

^b Fang I-Chih in his *Thung Ya*, ch. 48, agreed with this.

^c Notably of late from the Tien kingdom tombs at Shih-chai Shan in Yunnan.

^d Cf. Chang Hung-Chao (8), p. 101.

^e See, for instance, the paper by Jope (3) on early medieval spurs; and Theophilus, III, 92.

^f There remain also, of course, other alternatives, such as arsenical copper and As-plating (p. 241). I take special pleasure in quoting this interesting study, for I saw much of Dr Chang Tzu-Kung in Chungking and Nan-wên-chhüan during the second world war, and afterwards he worked some time in Cambridge. This paper of his covers much the same ground as the present sub-section, but it proved very difficult to obtain and it reached us too late to act as our guide.

^g Ch. 10, pp. 2b, 3a, tr. auct.

¹ 李紳

⁷ 丹陽化銅

² 鑄

⁸ 薛駝

³ 鑄

⁹ 蘭陵

⁴ 沃

¹⁰ 煨砒粉

⁵ 茨

¹¹ 惟湛

⁶ 白鐵

Tao for a whole month, for it can turn two ounces of copper into brilliant silver. If we reckon according to the market prices, all the metal-workers know that a further two tenths of an ounce of copper can be added to the (two ounces of) silver thus made, and hence for every ounce (of my starting material) they always give me two hundred (cash) more.'

His reagent was white and lustrous, and he made it into (little) pills with jujube-date flesh. After the copper had become molten (in the fire) he would add such pills to the crucible. Soon the impurities in the copper would form a viscous slag floating on the surface, and after the addition of some saltpetre, and stirring, (the metal) could be poured out into a mould. It was really brilliant silver, and its ductility would never change even though subjected a hundred times to the fire.

'This', he said, 'I have tried (many a time) personally with success—it is no fable.'

He later agreed to teach me his methods, but I afterwards lost touch with him because of the civil commotions.

This interesting testimony may well be the fullest account that we have of the making of cupro-nickel in the Chinese Middle Ages. First noted as such by Huang Tzu-Chhing,^a it has been accepted in this sense by Yuan Han-Chhing^b and Chang Tzu-Kao^c though others feel it more probable that simple arsenical copper may have been the explanation of the 'silver' produced.^d Although the text leaves the economics of the operation still slightly obscure, the Taoist was evidently able to make a good living out of his art, and we are provided with an unusually precise figure, seeing that 4.55% of something, whatever it might have been, was added to the copper in the crucible. The proportion would be just about right for arsenic alone,^e but rather low in nickel if its arsenide were being used to make paktong;^f however, one should probably not lay too much weight on the quantitative data of an +11th-century text.

The advantage of knowing that Hsüeh Tho's technique was called a 'Tanyang method' is that we can trace back paktong and arsenical copper much further in history because of this name. Ho Wei opens the same chapter of his book with the following significant story:^g

As for the affairs of elixirs, chemicals and furnaces; scholars, high-ranking ministers, and learned Taoists ensconced in mountain and forest retreats, all love talking about them and searching them out; I should think that seven or eight out of ten are like this—but I doubt whether all of them are bent upon getting the chemical medicines of immortality to become *hsien*.

For example, San Mao Chün¹ (the three Lords Mao) were at Tanyang (long ago) during a famine year when many people died, so taking certain chemicals (Mao) Ying² projected them on to silver, turning it into gold, and also he transmuted iron into silver; in this way saving the lives of (untold) hungry people (by enabling grain to be bought and transported).

^a (1), p. 729. Again I am glad to quote this paper, for during the second world war I saw much of Prof. Huang in and around Kunming (cf. the references in Needham & Needham, 1).

^b (1), p. 64.

^c (2), p. 113.

^d Sun & Sun (1), p. 258.

^e 3.52% allowing for the oxygen in the oxide. Cf. p. 166 above.

^f 2.04% allowing for the arsenic in the ore. Cf. p. 178.

^g Ch. 10, p. 1a, tr. auct.

¹ 三茅君

² 盈

Therefore afterwards all those who prepared chemical powders by heating, and transmuted copper by projection, called their methods 'Tanyang techniques'.

So also those who use deadly arsenical substances to project on to copper call their methods 'projecting the (yellow) water-mallow' (*tien mao*¹).^a There are also those who take chemicals and by cyclical processes 'subdue the red' to 'foster the yellow water-mallow', or 'kill' sulphur to fix mercury—such as Wang Yang^{2b} or Lou Ching^{3c} of the Han, or Chhêng Pi^{4d} in the Thang.

And he goes on to talk about the exploits of his Sung contemporary Wang Chieh,⁵ fully described by us at a later stage (pt. 3 below). Mao Ying himself is a tolerably historical character whom we shall also place in his temporal context later on (pt. 3), 'the eldest of the three Lords Mao',^e a great Taoist scholar of the Former Han whose *floruit* must have been c. -50 to -30.^f Tanyang was presumably the city in Chiangsu near Nanking. The interesting thing is that he keeps on turning up in texts which are probably referring to paktong and arsenical copper.^g Perhaps one should not take the actual conversions mentioned by Ho Wei too seriously, but it could be that continued heating of 'silver' (copper whitened by arsenic) would drive off the volatile element and convert it to a reddish 'gold'. Similarly the 'iron' might have been a dull brass which could lose zinc by volatilisation on prolonged heating and change to 'silver' on the addition of nickel ore.

'Tanyang copper' has quite a venerable literary history, centering on the San Kuo period (+3rd century). Ko Hung mentions it once,^h saying of a certain mercuric elixir preparation, not so far identified, that 'if it is thrown into Tanyang copper and heated, gold will be formed'. This is important because it shows that about +300 'Tanyang copper' was not already golden itself; here it would have been silvery, and therefore at this time it may well have been paktong, as the circumstantial account of Hsüeh Tho's activities has already suggested. On the other hand, at a date which may have been a little earlier than the *Pao Phu Tzu* book or else a century or so later, the writer of the *Shen I Ching*⁶ (Book of the Spiritual and the Strange), describing a metal statue of a man standing among some Western wilderness mountains, said that it was made of silver, tin, lead, and Tanyang copper.ⁱ Explaining this:

^a This plant is some species of *Brasenia* (*peltata*, *Schreberi* or *purpurea*), one of the Nymphaeaceae; R540; CC1447; B II398, B III199. Perhaps the name here was a pun.

^b See pt. 3.

^c Cf. p. 258 below.

^d See pt. 3.

^e The three brothers became the patron saints of the great Mao Shan school of Taoism, the three peaks of that mountain near Nanking being named after them (cf. pt. 3).

^f This date is particularly intriguing because it was just after the celebrated failure of Liu Hsiang (cf. p. 48 and pt. 3 below) to produce alchemical gold under immediate imperial auspices. Perhaps in his case there were too many people about who understood cupellation.

^g For example Yü Yen,⁷ in his *Hsi Shang Fu Than*⁸ (Old-Fashioned Table Talk), c. +1285, retells the beneficent acts of Mao Ying (cf. Chang Hung-Chao (1), p. 322).

^h *PPT/NP*, ch. 4, p. 13b, elixir no. 33 (cf. pt. 3). Ware (5), p. 88, 'nodding' (as they used to say), missed the significance of the name, translating 'male copper', but he guessed that arsenical copper was involved.

ⁱ Ch. 5, p. 2a. This image is irresistibly reminiscent of that other made with various metals, and with feet of clay, which appeared in the dream of Nebuchadnezzar (Nabuchodonosor II) and was interpreted by Daniel (Dan. ii. 33) about -585. Could there be any connection?

¹ 點莸

² 王陽

³ 葉敬

⁴ 成弼

⁵ 王捷

⁶ 神異經

⁷ 俞琰

⁸ 席上腐談

'Tanyang copper' looks like gold; it can be forged (*tuan*¹)^a and used for the inlaying and plating (*tsho thu*²) of vessels. The 'Arts' of Huai-nan has a sentence about 'taking internally the false gold of Tanyang'.

Comm. Later people confused this with the 'classic' of Huai-nan (i.e. the *Huai Nan Tzu* book). Also Chien Wên Ti of the Liang has a poem which speaks of Tanyang copper being used for inlaying swords.

Here the reference is obviously to the *Huai-Nan Wan Pi Shu* (Ten Thousand Infallible Arts of the Prince of Huai-nan), which we discuss in its proper place (pt. 3), but the quotation about using Tanyang copper as an elixir is not to be found in any of the modern reconstructions of that ancient formulary. As for the Liang emperor mentioned, Hsiao Kang³ by name, he reigned for only one year (+550), and we have met him already in various technological connections.^b The important point is that Wang Fou,⁴ or whoever wrote the *Shen I Ching*, thought of Tanyang copper as golden in colour. So did Mêng Khang⁵ earlier in the +3rd century. Commenting on the passage in the *Chhien Han Shu* which says that yellow metal was the highest grade of exchange media, with white metal as the second, and red metal as the third (cf. p. 51 above),^c he says, naturally, that white metal means silver (*yin*⁶) but also, unexpectedly, that red metal means Tanyang copper. Presumably he had in mind some reddish sort of artificial 'gold', but one would have thought that low arsenic arsenical copper might have given rather porous metal for the typical Chinese cast coinage, and we do not know of any archaeological evidence that it was ever so used. To sum it all up, we suspect that the traditions taking back both paktong (cupro-nickel) and arsenical copper to the group around the prince Liu An in -120 may have been well justified, especially as this time was just after the occupation of northern Yunnan.

But it is doubtful whether we ought to think of this subjugation of the valley of the Upper Yangtze which today separates the provinces of Szechuan^d and Yunnan as an absolute limiting factor for the time when nickel ore was first mined and worked. The Yunnanese State of Tien^{7e} had been founded in -334 as a colony from Chhu,^f and trade relations with central China must have existed during the Chhin period. Han Wu Ti, however, did not meet with the same success in the South-west as he had in Central Asia after the travels of Chang Chhien (-138 to -126),^g or in South China (Yüeh),^h or in Korea (Chao-hsien), so he recognised the King of Tien, conferring upon him in -109 a gold seal of authority which has been recovered by excavation in our own time at Shih-chai Shan.ⁱ Even if the nickel therefore was not strictly in

^a This implies considerable ductility, just as one would expect of copper with 2% arsenic. Cf. Charles (1).

^b E.g. Vol. 4, pt. 2, pp. 234, 577.

^c Ch. 24B, p. 10a. Swann (1) makes no comment at the place.

^d A part which was formerly Sikang province.

^e In the region of modern Kunming.

^f Cf. Vol. 1, pp. 93 ff.

^g Vol. 1, pp. 173 ff.

^h Vol. 4, pt. 3, pp. 441 ff.

ⁱ On these important tomb finds, at a site near the Kunming Lake, and dating from about -100, see Anon. (28) and Wang Chiung-Ming (1).

¹ 鍛

² 錯塗

³ 蕭綱

⁴ 王浮

⁵ 孟康

⁶ 銀

⁷ 滇

Chinese imperial hands by the beginning of the — 2nd century, it may already by then have become an article of trade, either as the arsenical mineral, or as unpurified high nickel copper, or possibly a mixed matte of sulphides.

(ii) *Chinese nickel in Greek Bactria?*

These origins are of considerable importance for ancient trade and technological history because of the remarkable fact that the Greek kingdoms in Bactria during the first half of the — 2nd century used a cupro-nickel coinage, so far as is at present known the oldest in the world. This was the discovery of Flight (1) in 1868, who found 20% nickel in a coin of Euthydemus II dating from approximately — 180 to — 170, and later (2) established that coins of his younger brothers Pantaleon and Agathocles (— 170 to — 160) were of a very similar alloy.^a This discovery is not in dispute and has been confirmed by a number of more recent analyses both by the classical wet method^b and by X-ray fluorescence spectrometry^c (cf. Table 101). It is out of the question that such proportions could have been inadvertent, and deliberate alloying must inescapably be envisaged (cf. Fig. 1325).

Knowing the Chinese background of paktong, Cunningham (1) in 1873 proposed that the nickel of these Graeco-Indian coins must have come overland somehow from China; thus initiating what came to be called the 'Bactrian nickel theory'. It won considerable favour for a time, being accepted by such eminent scholars as Tarn^d and Marshall,^e and historians of metallurgy like Friend,^f but it was severely criticised by others, e.g. Caley (4) and Cammann (4), mostly on the ground that long-distance trade in heavy minerals or metal ingots at that date, either through Burma, Assam and India, or even across Sinkiang, was inconceivable. Chêng & Schwitter (1), in bringing forward their new analyses, somewhat injudiciously supported their belief in the Chinese origin of Bactrian cupro-nickel by the Szechuanese cloth and bamboos which Chang Chhien identified in Bactria and thought must have got there by way of India;^g but the real strength of their case lay in quite a different approach, a metallurgical demonstration that the ratios of the constituents in the Bactrian alloys (copper, lead, iron, nickel and cobalt) are closely similar to those in classical Chinese paktong, and a further submission that out of nine known Asian nickel deposits only those in China would have been likely to give the ratios found.^h

^a Others having the image and superscription of the contemporary sub-kings Apollodotus and Philoxenos appeared to be also the same.

^b British Museum, 1962, in Howard-White (1), p. 10, up to 20.9% Ni. Also Case (1).

^c Chêng & Schwitter (1), 1957, up to 13.8% Ni; and British Museum, 1962, in Howard-White (1), p. 11, up to 21% Ni.

^d (1), pp. 87, 111, 363.

^e Taxila Report (1), vol. 1, pp. 40, 107, 129, vol. 2, pp. 571–2.

^f (2), pp. 294 ff. Also Howard-White (1).

^g See again Vol. 1, p. 174. In spite of Cammann (4, 5) many good scholars believe in the existence of this trade route, for which Yü Ying-Shih (1) offers new arguments.

But Chêng & Schwitter also exposed themselves to criticism by accepting the *wu*¹ of the *Shih Ching* as cupro-nickel, which is highly improbable (cf. p. 232 above). It is true that they might have claimed the authority of Chang Hung-Chao (6) for this, but it will not do.

^h Weighty evidence, this, but not conclusive, for none of the Persian nickel deposits, e.g. in the Anarak district, nearer Bactria, were considered. Cf. Wulff (1), p. 16; Curzon (1), p. 519.

The paper of Chêng & Schwitter provoked what can almost be called a diatribe by Cammann (5), filled with unnecessary but characteristic acrimony, and followed by ripostes on both sides.^a But when the dust had cleared the facts remained as before; Cammann could make mincemeat of the sinological scholarship of the two metallurgists, but Chêng & Schwitter could analyse an ancient alloy and tell one ore from another, which was more than he could.^b Contrary to his contention, metals did travel in antiquity and the early Middle Ages, often in the form of pigs or cakes rather than fabricated articles, for example 'Seric iron'^c westwards, Persian brass eastwards,^d Indian wootz and Bideri metal, Damascus steel; and a hundred other metallic products listed as tribute in the Chinese dynastic histories. An outstanding example would be constituted by paktong itself, if indeed that is the right interpretation of the Chinese metal so renowned among the Arabic alchemists as *khārṣīnī* (Chinese arrow-head metal) or *ḥadīd al-ṣīnī* (Chinese iron), used for mirrors, and counted by them as the seventh of the standard metals.^e Most of the arguments in Cammann (5) are very weak,^f and perhaps the only one that remains with the reader is that if the Bactrian cupro-nickel had really come from China one would hardly expect to see the supply fade out completely just before the Han empire opened up substantial trade with Central Asia, as happened with the opening of the Old Silk Road about -110. But all sorts of arbitrary circumstances, including the demise of the Euthydemid house, could account for the end of the Graeco-Indian cupro-nickel currency. What is more hard to visualise is the carriage of the raw materials, as nickel arsenide, mixed oxides, nickel-rich copper cakes, or even a sulphide matte, first across the Tien-Han frontier or border-region and then by trans-tribal or city-State trade across the whole length of Sinkiang. Nevertheless, in spite of all, we are inclined to believe that this was what happened.^g

And so we are able to come back from this digression to alchemy and aurification, and

^a Chêng & Schwitter (2) produced further evidence on trace elements indicating Chinese origin, and stuck to their guns about Chang Chhien's bamboos. Cammann (11) still refused to believe in the possibility of trans-Asian trade in metal at that time.

^b Cammann was fond of the term 'nickel bronze', but this was surely a misnomer, for paktong rarely has any substantial amounts of tin, and the Bactrian coins certainly did not.

^c Whatever that was; see Sect. 36, and meanwhile Vol. 1, p. 183 and Needham (32), p. 14. Since Cammann mentioned and accepted this trade, it was almost quixotic to deny the travel of paktong in the same era.

^d Cf. pp. 201-2, 220 above.

^e See Laufer (1), p. 555; Stapleton, Azo & Husain (1), pp. 321, 340ff., 370, 405ff. The other chief suggestion is metallic zinc, but *khārṣīnī* was already prominent in al-Rāzī and the Jābirian Corpus (c. +900), which might be a little early for zinc. And there are certain other indications pointing strongly to paktong. But since a number of Arabic texts enlarge on the poisonous nature of the arrow-heads it would perhaps be unwise as yet to exclude high arsenic copper. Whatever it was, it travelled from China to the Arabs many centuries long. We discuss the matter fully in Vol. 5, pt. 4.

^f Notably his claim that in early times *pai tung*¹ meant 'white bronze' or speculum metal (cf. Table 97), i.e. pale high-tin bronze. There is no instance known to us, as in the *Khao Kung Chi*, where one might expect it, of the application of this term to such an alloy. That this impression is almost certainly correct is confirmed by our colleague Dr Chêng Tê-Khun, who very kindly at our request made a search of the inscriptions on Shang, Chou and Han bronze vessels and mirrors, as well as in ancient texts, with entirely negative results in this respect.

^g Yuan Han-Chhing (1), pp. 21, 64, concurs.

¹ 白銅

to note the significance of the fact that the period of Euthydemus and his brothers and successors (—180 to —150) was just exactly that of the Chinese industry of making false gold and silver which met its Waterloo^a in the 'anti-coining' edict of —144 (cf. pp. 12–13). Consequently we are left with the impression that besides the various forms of gold-like brass which we have admitted for that period (and for Li Shao-Chün's auri-faction as well) we should not be too ready to exclude the presence of the cupro-nickels and the arsenical coppers also. Perhaps what attracted the Euthydemid kings and sub-kings for their coinage was precisely the sort of stuff which the experts of the *wei huang chin*¹ art were concocting in China from the end of the —3rd century onwards—or even in the —4th, if Tsou Yen and his school knew as much as some hints go to show that they did.^b

In all this we have been dealing with the 'far away and long ago', yet it is remarkable how topical the subject is, as may be seen by taking a brief survey of the metals used in contemporary currencies.^c At the time of writing, not a single one includes coins of the traditional gold and silver, even in forms considerably debased with copper. Pak-tong, in the form of cupro-nickel, has become today the most popular coin metal throughout the world, cheaper than pure nickel (excellent for the purpose though that is), and easier to melt, cold-roll and anneal. It is used for all the British white coins, including the heptagonal fifty new pence (ten-shilling) piece, the most valuable production coin of any country. Classical paktong (the so-called 'nickel-silver', copper, nickel and zinc) comes next in favour, much used by Portugal, the Philippines and African countries; it is cheaper than cupro-nickel but more tricky to prepare since extra zinc has to be added to the melt to compensate for volatilisation. The nickel content may fall to 1%, as in the 'nickel-brass' of our former dodecagonal threepenny bits, but the minting is then made difficult owing to work-hardening during rolling, and this coin-alloy is the easiest of all to counterfeit, as happened with the former Indian two-anna pieces. Even when composite coins are made, the mild steel or copper core will be sheathed or 'clad' (as in North and South America) with paktong (cupro-nickel). Far less popular than any of these come the coins of acmonital or stainless steel^d (Italian, French and Turkish), limited to low-relief designs and quickly spoiling their dies; as also those of aluminium, which have poor wear resistance, light weight and trumpery appearance. A brassy bronze, low in tin and zinc, is still widely used, however, for smaller denominations; and copper with 8% aluminium, giving a distinctive yellow colour, is also sometimes employed for them. When one considers all this in relation to the fact that an enormous tonnage of paktong is still annually produced for the body-alloy of 'electro-plated nickel-silver' used for hotel and restaurant tableware throughout the world, as well as in private homes, one feels that the

^a Temporarily, of course.

^b See pt. 3 below.

^c See the expert summary of Deane (1).

^d 'Stainless steel' was first produced in 1914 by H. Brearley, who added about 14% of chromium to a low or medium plain-carbon steel. It was later found that 8% Ni with 18% Cr gave the most stainless of steels (Aitchison (1), vol. 2, p. 583), so that the 'Chinese metal' came to have a hand even in this too.

¹ 僞黃金

Table 102. Other silver-like and white or grey alloys (percentage compositions)

	Cu	Sn	Zn	Cd	Pb	Mn	Fe	Al	Ni	Co	Mg	Sb	Bi	As	W	Colour and properties
arsenical copper	95.4	—	—	—	—	—	—	—	—	—	—	—	—	4.6	—	for the gold-like alloy see Table 99, and in general pp. 223 ff.*
'Chinese alloy'	80.83	10.67	—	—	—	—	—	—	—	—	—	8.5	—	—	—	antimonial bronze, like speculum metal (Hiscox (1), p. 73)
Clark's metal	75	1.5	7.5	—	—	—	—	—	14.5	1.5	—	—	—	—	—	'imitation silver', cupro-nickels
Baudouin's metal	72	2.5	7.1	—	—	—	—	0.5	16.5	1.8	—	—	—	—	—	with Co and Al
'ferro-argentan' or Paris metal	70	—	5.5	4.5	—	—	—	—	20	—	—	—	—	—	—	very like silver, a Cd cupro-nickel
white alloy	65	32-34	—	—	—	—	—	—	—	—	—	—	—	2-3.5	—	'imitation silver', arsenical speculum metal
cupro-manganese	65	—	5	—	—	20	—	—	10	—	—	—	—	—	—	silvery-white, good for castings, a Mn cupro-nickel
minargent	56	—	—	—	—	—	—	1	40	—	—	—	—	—	3	very like silver, 'imitation silver'
argasoid (or arguzoid)	55.8	4	23	—	3.5	—	trace	—	13.4	—	—	—	—	—	—	also an 'imitation silver'; a paklong with Sn and Pb, almost ductile, better for casting
'bismuth bronze'	45	16	21.5	—	—	—	—	—	32.5	—	—	—	1	—	—	hard, resonant, corrosion-resistant, used for piano-strings
Toucas' metal	35.5	7.5	7.5	—	7	—	7	—	28.5	—	—	7	—	—	—	imitation silver but hard to work
tutania	53.5	19.5	—	—	—	—	—	—	—	—	—	23	—	—	—	Wm. Tutin (+1770), for shoe-buckles
antimonial cupro-nickel	25	—	—	—	—	—	—	—	24	—	—	50	1	—	—	hard, lustrous, used for lamp-reflectors
Indian Bideri metal (Hyderabad)	3-11	1-2	84-93	—	3	—	—	—	—	—	—	—	—	—	—	a very high-Zn brass, corrosion-resistant, cast into utensils
Britannia metal	1-10	75-94	0.5-3	—	1-11	—	—	—	—	—	—	5-25	—	—	—	for small castings, 'tin soldiers', since c. +1770
Tourun-Leonard metal	8.5	91.5	—	—	—	—	—	—	—	—	—	—	—	—	—	silvery, a very high-tin bronze
sideraphite	5	—	—	—	—	—	64	4.5	22.5	—	—	—	—	—	4	'imitation silver', corrosion-resistant but difficult to make
soft solder	—	60	—	—	35	—	—	—	—	—	—	—	5	—	—	Japanese pseudo-speiss, added to bronze; see Gowland (11)
brass solder	44	4	50	—	2	—	—	—	—	—	—	—	—	—	—	
liquation shrome	72.7	—	—	—	8.53	—	—	—	—	—	—	4.27	—	11.37	—	

minofer	4	66	9	—	—	—	1	—	—	—	—	20	—	—	—	} antimonial high-Sn bronzes, like Britannia metal matt white, darkening with time. For vessels to hold wine or vinegar, Pb must not be above 18 %
Ashberry metal	2-3	78-82	1.5	—	—	—	—	—	2	—	—	16-20	—	—	—	
pewter	1.7	80-90	—	—	10-20	—	—	—	—	—	—	5-8	—	—	—	
printing type metal	—	5-20	—	—	60-82	—	—	—	—	—	—	15-30	—	—	—	} compositions very variable silvery white, melts at 70° C. melts at 95° C. Cf. p. 34
Lipowitz' fusible alloy	—	13.5	—	10	26.5	—	—	—	—	—	—	—	50	—	—	
Newton's fusible alloy	—	30	—	—	20	—	—	—	—	—	—	—	50	—	—	
Warne's metal	{	37	—	—	—	—	—	—	26	11	—	—	26	—	—	} 'imitation silvers', white and fine-grained but not easily fusible 'cast diamonds' for stage jewellery, and 'tin soldiers'
Fahlun brilliants	{	50	—	—	—	—	—	—	—	15	—	—	35	—	—	
		60.4	—	—	39.6	—	—	—	—	—	—	—	—	—	—	
argentine	—	85.5	—	—	—	—	—	—	—	—	—	14.5	—	—	—	} silvery, used for seats of stopcocks 'imitation silver'
Trabuk metal	—	87.5	—	—	—	—	—	—	5.5	—	—	5	5	—	—	
Babbitt anti-friction bearings metal	3.7	89	—	—	—	—	—	—	—	—	—	7.4	—	—	—	
																these alloys are of very variable and complex composition, Cu, Sn, Pb or Zn, and Sb, predominating
Dewrance's metal	22.2	33.3	—	—	—	—	—	—	—	—	—	44.4	—	—	—	a high-Sb bearings metal
propeller bush alloy	5	26	69	—	—	—	—	—	—	—	—	—	—	—	—	a high-Zn bearings metal
magnolia metal	—	6	—	—	78	—	—	—	—	—	—	16	—	—	—	a high-Pb bearings metal
magnalium	—	—	—	—	—	—	—	70-90	—	—	—	10-30	—	—	—	white, taking a higher polish than silver, but brittle if more than 15 % Mg
duralumin	3.6	—	—	—	—	0.4	0.6	94.9	—	—	—	—	—	—	—	+ Si 0.5 %. Highly polishable and of great strength

* Moreover, arsenical copper high in As is very prone to what is called 'inverse segregation', a process in which arsenic-rich liquid exudes during the final stages of solidification to cover the external surface of the object, making it smooth and silvery. Besides this, copper and bronze can also be arsenic-plated by a cementation, arsenious oxide and powdered charcoal being applied as a paste and heated gently at about 400° C. The heavy white coating on the Horoztepe bulls (~3rd millennium) is a compound, probably Cu_3As , doubtless put on in this way. We are much indebted to Mr J. A. Charles for our information on these effects. They have a special interest because they are neither silvering *sensu stricto* (p. 246), nor surface-enrichment of precious metal (p. 250), nor yet surface-film 'bronzing' (p. 251), even though arsenical vapours were often involved in that. One would be inclined to predict with some confidence that as more metallurgical work is done on ancient Chinese objects, more evidence of the use of arsenic will be found, so prominent was it in alchemy from the Han onwards.

† This alloy was much used as a base for the inlaying of gold and silver, the metal itself being 'bronzed' or 'tinged' a blackish colour by dipping in a mixture of sal ammoniac, nitrate, salt and copper sulphate (cf. Hiorns (1), pp. 232 ff.). See p. 255 below.

modern world owes a great debt to the alchemical adepts and technicians of ancient and medieval China who first studied and made use of nickel.

(iii) *Other silvery alloys*

There remain a number of other silvery alloys, well known today, which could in some cases conceivably have been made by the ancient and medieval Chinese alchemists; these are assembled in Table 102.^a In considering them one must bear in mind the reservations about certain elements (e.g. aluminium and manganese) which have already been set forth (p. 189 above). Some, like Clark's metal, are close relatives of paktong, but containing cobalt, an element that could have been used empirically, by importation before the Ming, and from indigenous sources later. Cadmium was not isolated until 1817 (by Stromeyer) but since it so frequently accompanies zinc it could have entered compositions if use was made of Chinese zinc sources containing it. The arsenical coppers and bronzes have been discussed already (p. 223). The possible addition of antimony and tungsten arises from the abundance of these elements in China (p. 191), so that an alchemist who used their salts and ores, even though these never got names or entries in the pharmaceutical natural history literature, might have been able to produce alloys similar to minargent, Toucas' metal, tutania, antimonial bronze and Britannia metal. For Ashberry metal, again, all the constituents were available, and for that matter for sideraphite also (with the doubtful exception of aluminium), though in the absence of modern methods that could have been extremely difficult to make. Pewter, on the other hand, was certainly made in quantity, though it might have required a rather naïve patron to take it for silver, even in early times; and as for the silvery fusible metals which depend so much on substantial proportions of bismuth, the question must for the present remain open.

(5) AMALGAMS

In all the foregoing little or nothing has been said about mercury, yet without doubt it was one of the foremost reagents on the alchemists' shelves. In the *Hsin Hsiu Pên Tshao* of +659 we find a particularly interesting passage in the original commentary of the entry on silver metal powder or filings (*yin hsiao*¹).^b What it says is that 'the chymic artists (*shu shih*²) are able to use cinnabar (mercuric sulphide) or lead and mercury, or "burnt" copper (*chiao thung*³)^c to make it. But this does not possess the

^a Ref. Hiorns (2), pp. 103, 265, 298, 305, 334, 343, 348, 413, 452, 456; Hiscox (1), pp. 50, 63, 70, 77, 78, 80; Bonnin (1), p. 89.

^b Ch. 4, p. 2a, cit. often thereafter, as in *Pên Tshao Yen I*, ch. 5, p. 2a, and *CLPT*, ch. 4, (p. 110.2); tr. auct.

^c This is a term of uncertain significance, intriguing however, because so closely analogous with the *kekaumenos chalkos* (κεκαυμένος χαλκός), *aes ustum*, of the Hellenistic proto-chemists. Tractates 'on the different sorts of burnt copper', attributed to Zosimus, are in the *Corp. Alchem. Gr.* III, xiii, III, xlv; cf. III, xxiii. Berthelot (2), p. 233, interpreted it as black cupric oxide. With this, copper amalgam could easily be formed. The terminology seems yet another mark of kinship between the practitioners of East and West (cf. pt. 4).

¹ 銀屑

² 術士

³ 焦銅

chhi of the natural substance (*tsao hua chih chhi*¹), so how could it be used in medicine?' A similar doubt and cautionary warning is found in the *Tan Fang Ching Yuan*² (Mirror of the Alchemical Laboratory), a book of the early Thang, certainly written before +800. 'When people use mercury and cinnabar to fabricate ("gold") vessels, it is a technique to make private profit, and this (material) should not be taken internally, for it contains the poisonous *chhi* of (this) metal.'³ Mercury was thus being used in argentification and aurification, so one cannot end the enquiry into uniform-substrate alloys without some mention of the amalgams,⁴ studies of which must certainly have been going on since the beginning of the Han period if not earlier. The *Shen Nung Pên Tshao Ching* (+1st century) says that mercury 'kills the poison (*sha tu*⁵) of gold, silver, copper and tin', which is probably a reference to amalgamation; and at the end of the +5th century Thao Hung-Ching remarks that it dissolves (*hsiao*⁶) these metals, making them into amalgams (lit. muds, *ni*⁵). Such statements are of course repeated in many subsequent texts, such as the *Yao Hsing Lun* (perhaps +6th).⁶

The amalgam with lead is a brilliant silvery white, liquid until 33% lead is reached, and of a crystalline structure at equal proportions; presumably small objects and vessels could be cast in it.⁷ Considerable solution occurs at 200° C., where the liquidus is 65% lead and the solidus 85%. Zinc forms a brittle white alloy with mercury, solid at 11% of the latter, and this must have been made from the +9th century onwards. Mercury and tin combine at room temperature and in all proportions when heated, forming a brittle tin-white alloy⁸ used at one time for silvering mirrors, and until quite recently for filling cavities of the teeth in dentistry.⁹ It is not generally known that this technique, first introduced to Europe by M. Taveau in 1826, originated in China, tin-silver amalgam being used for the purpose already in the Thang period.¹⁰ The copper-mercury amalgam is particularly silvery, in the 30:70 proportion thixotropic but setting so hard that it may be polished like silver—this as Gersnein's alloy has long been known as a valuable cement.¹¹ Even more than the lead amalgam it may have given rise to descriptions of alchemical projection. It is malleable and retains its lustre well in air unless blackened by traces of hydrogen sulphide. The amalgams of the precious metals naturally often appear elsewhere in these pages (pts. 3, 4, 5) and must have been known in China at an early time. As in the Hellenistic world, amalgamation was used there for extracting gold and silver from their ores (cf. Sect. 36), and for

¹ Or, 'of the element Metal'. The passage is quoted in *CLPT*, ch. 4, (p. 109.2).

² See Hiorns (2), pp. 353 ff.; Hanson (1).

³ All these cit. *CLPT*, ch. 4, (p. 107.2).

⁴ Cf. Roberts-Austen (2), p. 1139.

⁵ Cf. Berthelot (2), pp. 29, 37, 46, 64.

⁶ Frequently used compositions were tin-cadmium amalgam and tin-gold-silver amalgam.

⁷ As recorded by Li Shih-Chen in *PTKM*; cf. Lu Gwei-Djen (1), p. 387. The oldest mention occurs in *Hsin Hsiu Pên Tshao* (+659); see Chu Hsi-Thao (1). The dental amalgam was always known as *yin kao*⁶ in China.

⁸ Hiorns (2), p. 452; Hiscox (1), p. 65. Copper-mercury amalgam was the first dental amalgam to be used in Europe; Rieth (1) has traced it to a MS. of therapy and pharmacy drawn from the practice of Johannes Stocker of Ulm, who died in +1513. The question of a possible transmission of the technique from China remains open; if such a thing occurred it would belong to the +15th-century cluster. But knowledge of amalgams was common to East Asia and the Hellenistic West from early times. It is interesting that the dental amalgams are now known to be intermetallic compounds (Westbrook, 1).

¹ 造化之氣

² 丹房鏡源

³ 殺毒

⁴ 滑

⁵ 泥

⁶ 銀膏

gilding and silvering (p. 247 below).^a Both amalgams are found native in California and Chile but not, so far as we know, in China. Gold-mercury amalgam in the 66:33 proportion is waxy or pasty, but it will crystallise at low temperatures, as will a mixture containing only 0.1 % of gold. Silver amalgam can be soft, granular or crystalline, with a greater tendency to crystallisation than that of gold. Exactly what part all these amalgams played in the alchemical processes of the Chinese Middle Ages requires further consideration, and laboratory experiments made in the light of the numerous textual references would be well worth while.^b

A rather strange passage occurs in the *Pên Tshao Kang Mu* on *ling i*,¹ which in this context would have to be translated something like 'numinous tallow'. Li Shih-Chen says:^c

Taoist technicians (*fang shu chia*²) mix mercury with ox, sheep and pig fat, and grinding it into an ointment-like substance, use a stalk of *thung tshao*³ as a wick.^d Then they shine it on places where there are gold and other treasures, and so can distinguish between gold, silver, copper, iron, lead and jade, tortoises, snakes and all sorts of strange things. Therefore it is called 'numinous tallow'.

Perhaps this comminuting of mercury with fat and burning it like a candle may have had some magical significance, as the last lines suggest, but is it not possible that the account conceals some useful goldsmiths' or metal-workers' test? Our friend Mr J. A. Charles of the Cambridge Metallurgical Laboratory made some experiments with 'mercury candles' but without much success. If the candle was near enough to condense mercury visibly the result was obscured by sooting, and in any case one would expect amalgam films of the same thickness to be nearer in colour to one another than to that of the different metals involved. But perhaps differentiation was made by the oxidation colours, since the rate of oxidation would be much greater from the amalgam—yet any sooty flame would be reducing. In any case the experiment has not yet been tried exactly as Li Shih-Chen described it.

Lastly it should be noted here that all the imagery of physiological alchemy, discussed at length in Vol. 5, pt. 5, was based not on the mutual relations of mercury and sulphur, but on those of mercury and lead; a fact which shows how prominent amalgams must have been in the minds of the alchemists of early times before the differentiation of the *wai tan* and *nei tan* schools. This is not to say that cinnabar did not figure to some extent in physiological alchemy, as the type of a Yang thing containing Yin inside it; but a black substance was needed to represent Water element and the North, with a white one to symbolise Metal and the West. Lead and mercury filled this bill, and the formation of the amalgam, with the mysterious change of their normal

^a Cf. Berthelot (2), p. 37.

^b For example, in the Leiden papyrus X (nos. 13, 18) we hear of complex mercury amalgams of copper-silver-gold-tin type, recalling the dental amalgams just mentioned and presumably golden or silvery in colour. Since compositions of this kind have no use in modern technology their very appearance has long been forgotten, but if we want to reconstruct the processes of proto-chemists, whether Hellenistic or Chinese, they ought to be looked at again. See Berthelot (2), p. 66.

^c Ch. 9, (p. 56), tr. auct. We could not find any similar passage in *CLPT* editions.

^d Probably *Tetrapanax* (formerly *Fatsia*) *papyrifera* (B 11, 82; CC 597).

¹ 靈液

² 方術家

³ 通草

properties, was the model for the production of the *enchymoma*, or elixir within and of the body, by the *conjunctio oppositorum* brought about in the psycho-physiological exercises.

(6) THE TREATMENT OF METAL AND ALLOY SURFACES

So much for the uniform-substrate alloys that could or could not have been made by the alchemists in ancient and medieval China. What about the metallic objects which owed their golden or silvery appearance entirely to layers of greater or lesser thickness covering their surfaces? In terms of the precious metals, therefore, or what looked like them, we have to think of the following three types of process:

- I Surface enrichment (a) by addition of a layer of precious metal,
(b) by the withdrawal of a layer of base metal,
- II Formation of stable surface films.

That all these were appreciated and practised in medieval China will appear in the following pages, and it is not difficult to find passages in the writings of the scientific scholars of the past which show the clear distinction that they made between uniform alloys and surface layering or 'tingeing'. One such, from Ko Hung (c. +300), has already been given (p. 67 above), and this is a good place to adduce a second, written by the great alchemical and botanical physician Thao Hung-Ching¹ some two centuries later. In its entry for *fan shih*² (alum), the *Chêng Lei Pên Tshao*, after quoting the *Pên Ching*, cites Chhi Po³ as saying that 'it can turn iron into copper'.^a Then it goes on to a quotation from Thao, probably from his *Pên Tshao Ching Chi Chu* (c. +510):^b

Thao Yin-Chü [Hung-Ching] says: 'The yellow and black (or dark yellow) sorts (of alum) are called "bird-droppings alum"; these are not used in pharmacy but are only suitable for the plating (*tu*⁴) (of metals).^c When they are added to processed copper (*shu thung*⁵) (powder), being made into a paste with crude vinegar and smeared on the surface of iron, the iron is all turned to the colour of copper. But although the outside colour becomes coppery the material inside remains quite unchanged.

This is clearly a reference to a variant of the 'wet copper method' whereby copper can be precipitated, even on an industrial scale, by running mine waters rich in copper sulphate over iron scrap. We often refer elsewhere (pp. 24, 35, 67, 209) to this ancient technique, which was used as evidence for alchemical transmutation late into the Renaissance in Europe, and not decisively explained until the time of Jungius and van Helmont in the +17th century.^d Since copper, gold and silver are near the end of

^a Ch. 3, (p. 84.1), tr. auct. The remark of Chhi Po suggests, of course, the *Huang Ti Nei Ching*, which would make it at least as old as the -1st century, and probably a good deal older; but it is not in that text now. It could have come from the lost *Huang Ti Wai Ching*, and there were other books in which Chhi Po was an interlocutor; cf. *SIC*, p. 706. It had already been quoted in the *Hsin Hsiu Pên Tshao* of +659; ch. 3, (p. 22).

^b We give it more fully in pt. 3 below.

^c Besides what follows, there may be an implicit reference here to preparations for the cleaning of metal surfaces before gilding and silvering.

^d Pagel (15). It is remarkable to find that Ko Hung and Thao Hung-Ching were clearer about this than Libavius (+1600) and Sennertus (+1629).

¹ 陶宏景

² 礬石

³ 歧伯

⁴ 鍍

⁵ 熟銅

the electro-chemical series, they are easily displaced from solutions of their salts by other metals such as zinc and iron; hence the deposition. What exactly the 'yellow and black alum (*huang hei fan*¹)' was remains imprecise, but it was almost certainly a mineral containing both copper and iron sulphates, something like what the +18th-century chemists called German vitriol. Medieval Chinese terminology for the alums and the vitriols was a little confused, for while *fan shih*² undoubtedly comprised all the true alums, and copper sulphate was properly *shih tan*,³ it had synonyms such as *tan fan*,^{4,5,6} *shih fan*⁷ and *lan fan*.⁸ Similarly, ferrous sulphate, properly *lü fan*,⁹ had synonyms such as *chhing fan*,¹⁰ *tsao fan*¹¹ and *hei fan*.¹ One of the late Jesuits, Collas (5), wrote a special note on the *huang fan*¹ of commerce in his time, +1785, but he was not able to determine the constitution of this 'vitriol'.

(i) *Superficial enrichment; the addition of a layer of precious metal*
(gilding and silvering)

Of gilding and silvering (*tu*¹²) in China a literary history could of course be written, but we may be content with one single type-quotation, taken from the *Ku Chin Chu* (Commentary on Things Old and New) of Tshui Pao, c. +300. 'When the commander-in-chief is setting forth on an expedition he carries as insignia a yellow halberd made of copper (or bronze). The blade and the handle are covered over with gilding, for it would not be possible to use pure gold.'^a Broadly speaking it would be true to say that gilding and silvering came later in China than the inlaying of the precious metals, but that both processes were well known from the Warring States period (-4th century) onwards.

Some methods, the results of modern scientific knowledge, can be excluded when medieval procedures are under consideration.^b For example, (A) electro-plating, with solutions of the cyanides of the precious metals,^c or (B) contact plating, using the electro-chemical properties of different metals,^d or (C) dipping in solutions of gold salts so composed as to dissolve out some of the metal from the surface layers of the object and to deposit gold in its place, or (D) the precipitation of gold from solutions of its salts by means of a strong reducing agent, or (E) 'burning on' to porcelain or

^a Ch. 1, tr. suet.

^b Cf. Hiscox (1) for modern techniques, and the interesting survey of Bergsøe (2).

^c These may also be used alone, i.e. without passage of current. Copper, brass and some other metals can be silvered by rubbing with a mixture of potassium cyanide, silver nitrate and calcium carbonate (Hiscox (1), pp. 587, 642). Haschmi (5) believes that there is evidence in the Jābirian Corpus to prove that gold cyanide was made in the +9th or +10th century, and used to coat iron by ion exchange, but that remains to be seen.

^d A Jābirian text translated by Steele (3) mentions a substance like marble which could coat copper, iron, lead and tin with silver; Haschmi (5) suggests that this was silver sulphate or silver nitrate, capable of doing so by ion exchange. Elsewhere in the Corpus a 'red elixir' makes silver look golden and a white one makes copper look silvery—this might be explained on the same principle, but these texts need a good deal more investigation. The outstanding example of ion exchange coating is of course the deposition of Cu from solutions of copper salts on iron surfaces (see p. 245); this became an industrial method in medieval China. Cf. also p. 67 and pt. 3.

¹ 黃黑礬

⁷ 石礬

² 礬石

⁸ 藍礬

³ 石膽

⁹ 綠礬

⁴ 膽礬

¹⁰ 青礬

⁵ 丹礬

¹¹ 皂礬

⁶ 胆礬

¹² 鍍

glass by means of a chemical preparation of gold which gives up its gold on heating in the presence of a flux as adhesive. This last method, however, would have been used in the porcelain industry in the Ming and afterwards. By contrast with all these, gilding by means of gold leaf (F) is one of the most ancient of human techniques, going back to the Old Kingdom (—3rd millennium) in Ancient Egypt,^a and certainly to the —1st in China. The marvellous property of gold which allows such thin leaves to be hammered out of it was thus known in very ancient times, though the beating was not to such thinness as now, mostly to some 0.005 mm thickness rather than the 0.0001 mm of today. In China and Japan quality was judged by the colour of the leaf, orange being thought the best and used for gilding steel, yellow next for vessels and vases, green, the thickest, for the ornamentation of Buddhist and Taoist statues, with the beautiful results so well known to all familiar with East Asian art.^b The gold-beater's trade notwithstanding, applications of gold and silver foil, and even thin plates of the precious metal, continued late in all the old civilisations.

One particularly interesting type of this is (G) the diffusion bonding of silver on copper.^c If a bar of silver is placed on a thicker bar of copper and heated under pressure to a temperature of some 800° C.,^d a molten silver-copper eutectic forms at the interface and gives on cooling a very strong join without the use of any kind of foreign fusible alloy as solder. After the joint is made, the composite can be worked as one metal, since silver and copper have the same deformation characteristics. This is called 'Sheffield plate' because it became an industry in that city from +1743 onwards as the invention of T. Bolsover. We know now, however, that this was a re-invention (if not a transmission through obscure channels from ancient times), for the process has been demonstrated by Charles (2) in the silver-capped copper rivet-heads of a Minoan bronze dagger from Gournia in eastern Crete dating from —1700 to —1400; as also by Bernareggi (1) in silver-clad copper coins of the Roman Republic (—2nd or —3rd century). After the hot bonding, the dagger rivet-heads withstood cold-working (hammering and expansion) to fix the handles, with perfect success, and their tops were actually chamfered to accommodate the excess of molten eutectic. So far no example of plating by diffusion bonding has come to our knowledge from the Chinese culture-area, though it may well be found; but these facts raise a troubling question in sociological diffusion, that of whether, or how, the technique could conceivably have been handed down through the ages from Minoan Crete to eighteenth-century Sheffield.

Before the invention of electro-plating the gilding and silvering of metal objects by means of mercury amalgams (H) was by far the commonest method both in East and West. If gold is dissolved in boiling quicksilver a butter-like amalgam is obtained, and this is smeared over the cleaned metal surface by the aid of a brush or spatula, adhering as molten tin does when a piece of iron or copper is dipped in it. Then the mercury is

^a See Lucas (1), pp. 263 ff.

^b Julien & Champion (1), pp. 79 ff.; Moran (1). Metal surfaces were first submitted to the action of weak organic acids at boiling temperature.

^c And, interestingly, on paktong, as was done in the mid-nineteenth century (Aitchison (1), vol. 2, p. 535).

^d Mem. Cu, m.p. 1083°, Ag, m.p. 960.5°.

volatilised and driven off by heat, leaving a smooth gilded surface on which further layers can be deposited if the process is repeated, but the temperature must not rise above 500° C. as otherwise the gold may diffuse into the metal below it. Silvering, as for mirrors, is carried out in a similar way. Although they became so common as to be commonplace, there had been a time when these methods too had been a dazzling new invention, and for China this could most probably be placed in the Warring States period, perhaps some time before the life of Tsou Yen in the -4th century, when the properties of mercury were first being explored.^a The knowledge and use of amalgams seem to have developed *pari passu* in the West from Aristotle's time onwards. Theophrastus of Eresus (d. -287) knew that mercury was produced from cinnabar,^b and by the time of Vitruvius (-27),^c Pliny (+77),^d and Dioscorides (+2nd century)^e amalgamation gilding was standard practice. There are references to it in Pseudo-Democritus and other Alexandrian proto-chemical texts,^f abundantly so in the +3rd-century papyri.^g From this time also come mentions of a much clumsier technique, the laying on of an alloy of gold and lead, with subsequent removal of the latter by oxidation and volatilisation;^h this was very plausibly the remnant of an earlier time before the understanding of the use of mercury. The silvering of bronze mirrors by amalgam was also carried on in China at least from the -2nd century (cf. Fig. 1326), as we saw at an earlier stage.ⁱ

Gold surfaces could also be conferred upon metal objects by a process analogous to that of tinning^j which Bergsøe called 'fusion-gilding', though 'gilding' (I) would not be inappropriate. He established it for the work of the pre-Columbian Indians of the Esmeraldas coast.^k At a temperature of somewhat above 850° C. an object of copper can be run over with a gold-copper alloy containing about 20% copper, which adheres to the surface like molten tin; the rough surface can then be burnished or hammered out into a thin sheet. Bergsøe showed that a process of exactly the same kind can be used for silver, with even better results because the deformation characteristics of silver resemble those of copper more closely than those of gold do.^l Whether either of these methods was used by the Chinese medieval technicians we do not yet know, but it appears that an analogous 'fusion-plating' of iron with bronze was applied to some early Irish Christian bells.^m

^a On the history of mercury in China see pt. 3 below. A classical statement by Thao-Hung Ching on mercury gilding and silvering is translated there also.

^b Cf. Stillman (1), p. 18.

^c VII, 8.

^d *Nat. Hist.* xxxiii, *passim*, tr. and annot. Bailey (1).

^e Cf. Stillman (1), p. 44.

^f E.g. Berthelot (1), p. 272, (2), pp. 70, 71.

^g Caley (1, 2); Berthelot (2), pp. 37, 40, 52, 56, 58 etc. Cf. p. 16 above.

^h Berthelot (1), p. 244, (2), pp. 52, 58.

ⁱ Vol. 4, pt. 1, p. 91. This was generally done with tin, and the same process was used by the Alexandrian technicians and proto-chemists (Berthelot (2), pp. 35, 60, 72), as well as imitating silver with the amalgam as such (p. 243 above). But for precious objects silver amalgam could be used.

^j Cf. p. 233 above.

^k (2), pp. 29 ff.

^l As we saw in the case of Sheffield plate, p. 247. Bergsøe (2), pp. 37 ff.

^m Maryon, *priv. comm.* to Bergsøe.



Fig. 1326. Sun Chü, the mirror polisher (Fu Chü hsien-sêng);
Lieh Hsien Chhüan Chuan, ch. 1, p. 33a.

(ii) *Superficial enrichment; the withdrawal of a layer of base metal (cementation)*

The last two methods of surface enrichment which have to be discussed involve not the addition of a layer of a precious metal but the withdrawal of a layer of base metal. They consist essentially in the removal of copper (or any other easily oxidisable element) from surfaces of gold and silver alloys.^a In this way the tint changes to the colour of these two metals, and of course the resulting surface will pass the test of the touch-stone.^b There can be no doubt that such techniques were practised in ancient and medieval China, forming one of the ways in which the Han and later alchemical workers could have produced 'artificial' gold which would deceive the very elect. The surface-enrichment processes by withdrawal fall into two distinct categories, one which we might call 'leaching' (J) and the other cementation with salts (K). In the first case a preliminary heating in air leads to the formation of black copper oxide in the surface layers, and this must then be dissolved out and washed and scoured away. Nowadays goldsmiths use dilute nitric or sulphuric acids, but the leaching method is far older than the knowledge of these, and it is conjectured that the pre-Columbian Indians of America, who certainly practised it,^c used weaker organic acids, oxalic,^d acetic or malic, hot, just as would have been done in ancient China.^e Traditional Chinese recipes for cleaning metal surfaces before gilding and silvering contain much mention of mordant plant materials,^f and this points to the use of vegetable acids in the leaching process also.^g Bergsøe found by experiment that 20% gold in copper is about the lower limit for getting a durable golden surface by leaching.

Cementation proper is of course a more drastic process, and to put it in perspective we should look back to an earlier point where the general techniques of cupellation and parting were described (p. 38). While leaching will work to increase the silver content of surface layers, cementation is applicable only to gold, for its use of salt removes all metals, including silver, as the chlorides. Cementation was in fact a modification of

^a They are known in the trade as 'boiling in pickle' or 'colouring' (cf. Hiorns (2), pp. 386 ff.), 'mise en couleur' and 'Abkochung'.

^b This process can also occur by corrosion during long burial underground, as has been shown for coins of gold (Hughes & Oddy; G. F. Carter), and silver (Hendy & Charles; Condamin & Picon), and other objects of precious metal (E. T. Hall; Hall & Roberts), so it is important for numismatists and chemical archaeologists. It even occurs in nature, placer gold granules being richer outside than within (McConnell, 1).

^c For example, the pre-Inca Indians of Peru made 'silver-plated' objects (Antze, 1) by using an alloy of some 40% Ag and 60% Cu and strongly leaching the surface layers (Bergsøe (2), p. 39). Similarly the pre-Columbian Esmeraldas Indians leached the objects of copper which they had 'fusion-gilded' or 'gilded' as described above.

^d E.g. from *Oxalis pubescens*; Arsendaux & Rivet (1); Bergsøe (2), pp. 35 ff.

^e So, too, Dr Michael Hendy tells us, Arabic mint documents of the +12th and +13th centuries speak of the surface enrichment of coins as a regular practice. Cf. Levey (9).

^f Julien & Champion (1), p. 79, mention, for instance, *Physalis Alkekengi* and acid pears. A useful study of this subject could begin with the processes described in the *Shih Lin Kuang Chi* (cf. pp. 61-2 above).

^g 'It is known', wrote Hall (1), 'that the Chinese treated certain gold alloys with unripe peach juice for several years', but he gave no reference. It was probably from some report of the practice of the relatively recent past. Cf. the early Ming tractate translated and discussed by Ho Ping-Yü, Lim & Morsingh (1).

'dry parting'; it involved packing the object in common salt with brickdust or clay,^a copper and iron sulphates being also added, whereupon strong heating caused all the metals in the surface layers other than gold to be converted to chlorides and removed in the fumes or absorbed in the litharge and ash of the cupel-like container.^b How old this process was in China has already been considered (p. 55);^c the *Huang Ti Chiu Ting Shen Tan Ching Chüeh*, though a Thang compilation, takes us back to the +2nd century, so we may think of surface-enrichment by withdrawal as being known in the Han. This is straddled by dates in the Hellenistic period, Pseudo-Democritus^d of the +1st century and other references in later Greek proto-chemical writings, as also the technical papyri in the +3rd.^e Thus both in the Far Eastern and Far Western civilisations of the Old World it would seem that the extraction of base metal from the surface layers of objects, whether themselves made of debased (diluted) gold and silver, or previously surface-enriched by gilding or silvering with less debased alloys of the precious metals, could be successfully accomplished by about the turn of the present era. Obviously this gives us still further information on what the aurifactors and aurifictors of ancient China may conceivably have been doing as far back as Li Shao-Chün and the 'coiners' of *wei huang chin* in the first half of the -2nd century.

(iii) *The deposition of coloured surface-films ('tingeing', bronzing, pickling, dipping)*

With this we conclude what needed to be said about gilding and silvering proper, but there is yet a further group of techniques important for our understanding of alchemy and aurifiction, those namely by which permanent or semi-permanent surface films of microscopic thickness and a great variety of colours may be laid down upon the surfaces of metals. Most people would be very surprised to know how much can be done in this direction, not only to produce gold and silver appearances but also greens and blues,^f purples and violets, or finishes in bronze, grey and black; partly, perhaps, because all such techniques are known industrially as 'bronzing'.^g Thus copper can be given a brown bronze tint by treatment with iron oxide,^h made reddish-brown with

^a This takes up the sodium as silicate and aluminate. The work is effected by the vapours of hydrochloric and sulphuric acid which are evolved. Compositions in which the metals are treated are called 'chloridising roasts'. Cf. Fig. 1301.

^b There is a good account of cementation in Ercker (+1574); see Sisco & Smith (1), pp. 182ff.

^c For Japan cf. Gowland (6), p. 32; (7), p. 137. Hiorns (*loc. cit.*) describes how the salt processes are carried out today. In a bath of boiling HCl with concentrated potassium nitrate and sodium chloride the process takes only a few minutes; this is 'wet colouring'. Or the article may be dipped into a bath of molten alum with potassium nitrate and sodium chloride, then immersed momentarily in dilute *aqua fortis*; this is 'dry colouring'.

^d *Chrysopoia*, no. 8, *Corp. Alchem. Gr.* II, i, 12.

^e Pap. X (Leiden), nos. 20, 20a; cf. Caley (1). On both literatures see Berthelot (2), pp. 14ff., 16, 33, 34, 55ff., 58, 71.

^f Anyone who has ever spilt French dressing on a copper tray will have been struck by the brilliant blue caused by the acetic acid and acetates present.

^g See the interesting book of Hiorns (1) on this subject. The processes nearly always consist of a preliminary scouring or cleaning of the metal surface, immersion in the chemical 'dip' for various times at various temperatures, and subsequent drying under a variety of conditions.

^h This is the 'Florentine bronzing' introduced by Lafleur in 1828 (Hiorns (1), pp. 63, 103).

a violet tint by copper sulphate, turned purple by antimony chloride, dark green by copper sulphate and zinc chloride, and bluish green by the sulphate and acetate of copper.^a Brass can be made olive green by the chlorides of copper and iron, or dark red by the action of copper nitrate, while sodium thiosulphate and lead acetate together give an extraordinary variety of coloured films ranging through gold, yellow, pink, crimson, purple, blue and bluish green according to the temperature and time at which they are allowed to act.^b Significantly brass can be made to assume a golden colour (if not already by its composition possessing it) through the action of various mixtures of the acetate, carbonate, and chloride of copper, or with potassium ferricyanide or tartaric acid in caustic soda.^c Even copper can be endowed with a deep golden film by the judicious use of copper acetate and iron oxide.^d Strong effects are produced by sulphides, so that brass can be permanently blackened by potassium and ammonium sulphides,^e while silver, again most significantly, can be given any desired golden tint from pale to deep gold by the action of barium sulphide and ammonium sulphide.^f

Mention of the tinting or 'tingeing' of metals by sulphides rings a bell. Pondering on these modern workshop recipes might seem to be far removed from the interpretation of the Graeco-Egyptian papyri and the texts of the Hellenistic proto-chemists, yet the connection is close and direct.^g For it is certain that one of their major activities was the 'whitening' (*leucōsis*) of alloys containing copper, and the subsequent 'yellowing' (*xanthōsis*) of the product, by the operation of mercury, arsenic and sulphur either in the gaseous form or in solutions. Copper combined with gold, silver, tin or lead was whitened or 'silvered' by arsenic vapour,^h or by the sulphides of arsenic or mercury,ⁱ or by mercury vapour in the reflux condenser (*kērotakis*) producing a superficial film of silvery amalgam,^j or even by the application of tin amalgam itself.^k Yellowing was then carried out on silver, or on arsenical copper, or on complex copper alloys previously given a silvery arsenical or mercurial surface, by the action of sulphides. Of these, a mixture of calcium polysulphides (CaS_2 to CaS_7), the famous 'divine' or 'sulphureous' water, was a particular favourite,^l but ammonium sulphide

^a Hiorns (1), pp. 14, 103, 108, 225; Hiscox (1), p. 221.

^b Hiorns (1), pp. 193, 227, 230. Thiosulphate and antimony chloride give gold tones, but greys are produced if the treatment is too prolonged; *op. cit.* p. 192.

^c Hiorns (1), pp. 191 ff., 202; Hiscox (1), pp. 130, 570-1, and on 'antimony baths' p. 581.

^d Hiscox (1), p. 221; Hiorns (1), p. 103. Or a brick-red may be produced. Cf. *Corp. Alchem. Gr.* v, i, 13, and Hopkins (1), p. 101.

^e Hiorns (1), pp. 207, 208.

^f Hiorns (1), pp. 266, 268. If continued, the treatment gives iridescent crimson and purple shades, ending in umber or steely browns. The acetate ion has a great tendency to produce iridescent colours on metals (p. 154), which may be preserved by lacquering with transparent varnish, and the *Corpus* often mentions the use of vinegar, as do the papyri. It may be noted that nickel is also given a golden-bronze tint by barium sulphide. On colouring steel see Hiscox (1), p. 80.

^g It was the great merit of Hopkins (3) to show that the 'tingeing' processes of the Hellenistic 'artists' could only be fully explained in the light of the 'bronzing' methods of the present day. But he was probably wrong in interpreting the cementation recipes as exclusively bronzing ones (Pap. V, Berthelot (2), pp. 13 ff., Pap. X, no. 15, Berthelot (2), p. 31).

^h Leicester (1), p. 45; Sherwood Taylor (2), pp. 125 ff.; Hopkins (1), p. 46.

ⁱ Berthelot (2), pp. 71, 72; Leicester (1), p. 43.

^j Berthelot (1), p. 161; Leicester (1), pp. 43, 45.

^k Berthelot (2), pp. 35, 60, 72.

^l Leicester (1), pp. 39, 43, 68; Sherwood Taylor (3), p. 45; Berthelot (2), pp. 47, 68, 69. Cf. Mellor (1), p. 409; Partington (10), pp. 377, 693, 696.

prepared by the dry distillation of eggs (naturally cosmic and mysterious objects) was also used,^a and sodium sulphide would do almost as well.^b The very first process of gold-making (*chrysopoia*) of Pseudo-Democritus consists of 'an apparent silvering of copper followed by a superficial gilding'.^c A general reconstruction of Hellenistic aurifaction visualises three main procedures.^d In the standard method one started with copper and lead (*molybdochalcum*) or copper, lead, tin and iron (metal of magnesia), added silver or *asem*, flooded it with mercury or tin amalgam, obtaining a silvery surface with a yellow interior substance, added a little gold and then yellowed the exterior to a golden tint with calcium polysulphides. The final stage of 'purpling' (*iōsis*)^e may well have been analogous to one or other of the 'bronzing' procedures just mentioned, such as the action of copper sulphate, acetate and acetic acid on copper containing small amounts of gold (cf. p. 264 below).^f A method more primitive, perhaps, had acted upon the tinned surface of copper with copper acetate and ammonium chloride, changing it to a splendid yellow,^g while a later method, associated with Mary the Jewess, started with *molybdochalcum* alone, fused it with sulphur and whitened it with mercury or tin amalgam, then yellowed it with the sulphides. These reconstructions are of course conjectural, and stand in much need of full repetition in a modern laboratory, but they cannot be far from the truth.

Thus looking backwards we can see clearly two great traditions of metallurgy related to aurification and aurifaction, the making of uniform-substrate alloys on the one hand, and the 'tingeing' or 'dyeing' of metal surfaces^h by altering the composition of the surface layers, or by depositing microscopically thin coloured films, on the other. There can be no sharp distinction of course between them, since what can be done with the surface-layers or the films depends very often on the exact composition of the mass of metal beneath them. Some students of Hellenistic proto-chemistry have felt that they could descry a difference here between two cultural traditions, the Egyptian and the Persian respectively, and this is of some importance for us if Persian should be taken to imply influences still further Eastern in character. Bidez & Cumont concludedⁱ that the school of Pseudo-Democritus, following the example of their Persian master Ostanēs, preferred to work only in the 'liquid' way, by means of tinting, varnishing,

^a Leicester (1), p. 44. Hen's eggs are relatively rich in sulphur; there are sulphhydryl groups in the proteins of yolk and white, especially in livetin and ovomucoid, and there is also much sulphur in the keratin of the membranes. Yolk may also contain sulphylo-lipins. The spontaneous evolution of H₂S by egg-white on standing has long been known.

^b Berthelot (2), pp. 39, 59.

^c *Corp. Alchem. Gr.* II, i, 4; cf. Berthelot (2), p. 71; Hopkins (1), p. 64.

^d Hopkins (1), pp. 93, 103, 106. Cf. *Corp. Alchem. Gr.* III, xxviii, 2, 9.

^e *Corp. Alchem. Gr.* II, i, 7; ii, 5.

^f Cf. Hopkins (3).

^g Hopkins (1) based this on Leiden Pap. X, nos. 14, 15, 89, some of which may be susceptible of other interpretations. But the feasibility of the process mentioned has been shown experimentally by Hiorns (1), p. 107.

^h The Hellenistic Corpus uses the terms *chrōsis* (χρῶσις) skin-dyeing, *chrisis* (χρῖσις) anointing, and *katabaphē* (καταβαφή) immersing in dye, for this. As we shall presently see, the Chinese equivalent was, *inter alia*, *jan*.¹ Cf. Berthelot (2), p. 23.

ⁱ (1), vol. 1, p. 205, vol. 2, p. 314.

deposition of films, surface enrichment, amalgam gilding, etc., while the Egyptians always tended to make uniform alloys of very varying composition.^a And it is true that in one of the early documents, the letter of Synesius to Dioscorus, written at some time before +389, it is said:^b

Speaking of the great Ostanès, he [Pseudo-Democritus] attested that he did not make use of the projections of the Egyptians, nor of their processes of heating and melting; but that he operated upon substances by application (of other substances) from outside, effecting the chemical result by means of the fire (i.e. heating). And he said that it was the custom of the Persians to operate in this manner.

Our opinion is that this distinction should be treated with great reserve. There may perhaps have been a temporary polarisation of this kind in the +1st century, but that it was not very significant seems to be shown, partly by the presence of both types of technique in East Asian chemical technology,^c and partly by the fact that outstanding examples of surface-film effects had been and continued to be produced in Egypt. Here an excellent example can be found in the rose-pink gold sequins of Tutankhamun's slippers (c. -1350). This pink or rose-purple film on gold was not quite new in his time, for it occurs in jewellery of Queen Tiy some thirty years earlier, and it continued to be produced for a long time, as e.g. on a diadem of Queen Tewosret (XIXth dynasty, -1350 to -1200) and on some ear-rings of Ramesses XI (XXth dynasty, -1200 to -1090). Lucas was the first to show that the rose colour was not due to any organic covering nor to any colloidal modification of gold, on the contrary the metal could be made red-hot and hammered, often only enhancing the effect; but it contained a small proportion of iron.^d These observations were later followed up remarkably by Wood (1), who was able to demonstrate that the film, less than 1/100,000th of an inch thick, consists of iron oxide, and forms naturally if gold containing just under 1% of iron is heated in a certain way.^e Ostanès could have done nothing better.

Another example can be taken from quite a different quarter, India of the Mogul times and subsequently,^f where the town of Bidara sixty miles north-west of Hyderabad has produced cast vessels and utensils of many descriptions made of a very high-zinc brass (Table 102), indeed almost zinc alone, containing small amounts of copper, lead and tin, together less than 10% and descending in that order. This alloy has the

^a Cf. *Corp. Alchem. Gr.* II, ii, 1, Pseudo-Democritus to Pseudo-Leucippus; Berthelot & Ruelle (1), vol. 3, p. 57.

^b *Corp. Alchem. Gr.* II, iii, 1, 2, tr. Berthelot & Ruelle (1), vol. 3, p. 61, eng. auct.

^c Cf. pp. 67, 273 and pt. 3.

^d (1), p. 266, based on App. II of the Report on the excavation of the tomb.

^e Wood was able to take off the film with finger-nail polish varnish, after which all the colour was lost, but when he deposited gold on the back of it by cathodic sputtering the colour was restored. Besides the necessary amount of iron, the gold also contained some arsenic and sulphur, suggesting that orpiment might have been added by the goldsmith, but these elements are not necessary for the development of the pink or purple colour, and may have been native in the nugget gold to begin with, as the iron itself may well have been also. The process can be generalised by saying that small amounts of any reactive metal in gold can be expected to oxidise at the surface on heating and to produce coloured films (J. A. Charles). It is interesting that a pink tint can also be produced on silver by a hot solution of copper chloride (Hiorns (1), p. 270).

^f It is not clear how far back this technique goes. It would depend on what date is accepted for the beginnings of zinc smelting in India, a question to which we shall return in Sect. 36.

property of acquiring a blackish colour when 'bronzed' or 'tinged' by being dipped in a mixture of sal ammoniac, nitrate, salt and copper sulphate,^a after which artists inlay flower patterns and other forms of ornamentation done in silver and gold. This Bideri metal ware therefore has an appearance somewhat similar to the *niello* of the Mediterranean region, but it is made by the help of an alloy with special 'bronzing' properties, and not by depositing a mixture of metallic sulphides on to the silver or other metal base.^b

To what extent all these procedures were mirrored in ancient Chinese chemical technology is an interesting and important question, partial answers to which will be appearing as we go along, but a few relevant points may be made here. Certain parallelisms in the *Pao Phu Tzu* book have already been noted (p. 67 above), not only the appreciation of the surface-layer character of iron coppered by the precipitation of the metal from copper sulphate or carbonate,^c but also 'silver that has been transformed by white of egg, which renders the silver yellow like gold'. This inescapably recalls the sulphide *xanthōsis* of the Alexandrians,^d and one can only regret that Ko Hung was so sparing in the details he gave of the procedure employed to mobilise the sulphur from the eggs. Again, in reading the many accounts which will be given in the historical part of this Section one is often tempted to ask what was the fundamental basis of the association so common in China between cinnabar (mercuric sulphide) and gold or artificial gold. There must have been several reasons for this, first the preparation of mercury from the naturally occurring mineral and its use in the extraction of gold from auriferous sands and the like by amalgamation, secondly aurification by amalgamation gilding,^e thirdly the superficial *leucōsis* of copper and copper alloys by mercury followed by superficial *xanthōsis* brought about by sulphides. These are the sorts of processes which one can see in the background, reading between the lines of the statements of the Chinese alchemists from Li Shao-Chün onwards. There is a curious passage in Pliny's *Natural History* which relates how the emperor Caligula (r. +37 to +41) caused a great deal of orpiment (arsenic trisulphide) to be smelted for gold, of which indeed he obtained a small amount though not enough to pay for the work involved.^f Since it is the case that silver surfaces may be given a sulphide film and made to look like gold if they are smeared with orpiment and then lightly heated,^g and since in certain proportions arsenical copper can be golden,^h the story may conceal attempts

^a Ray (1), 2nd ed., p. 217; Hiorns (1), pp. 232ff.

^b The early +12th-century book of Theophilus is a good focal point for studying *niello* in the West (chs. 28ff., Hawthorne & Smith ed., pp. 104ff.). He used a mixture of the sulphides of silver, copper and lead, with borax as a flux (though later sal ammoniac was found to be more suitable), applied in the molten state. The art was known to Pliny (*Nat. Hist.* xxxiii, xlvi, 131, cf. Bailey (1), vol. 1, pp. 129, 227). On its history see Blümner (1), vol. 4, pp. 267ff., and Rosenberg (1), vol. 2; and on the details of the technique itself Maryon (6) and Moss (1).

^c It is interesting that this ancient method is still in use today (Hiorns (1), pp. 299ff.).

^d Cf. Berthelot (1), p. 244, (2), pp. 47, 68.

^e One should remember also argentification by the preparation of various amalgams, and their use in the surface silvering of various alloys.

^f xxxiii, xxii, 79; cf. Bailey (1), vol. 1, pp. 101, 202.

^g Private communication from Mr J. A. Charles.

^h Cf. p. 223 above. A rather clear account of the projection of arsenic to make golden arsenical copper is found in one of the texts of Olympiodorus (c. +500); *Corp. Alchem. Gr.* II, iv, 12.

at aurifaction;^a though it is equally possible that the Roman *auripigmentum* was associated with some true but poor auriferous mineral. The Chinese relevance is that the two sulphides of arsenic were so prominent in the early alchemy of that culture, and one is therefore very much inclined to believe that this form of surface treatment was also employed in the activities of the Han alchemists.

For the end of the +1st millennium this can be documented satisfyingly enough. The *Pao Tsang Lun*¹ (a text of c. +918) says that if realgar (arsenic disulphide) is heated with various plant substances it produces an extract and a precipitate the colour of which remains unchanged by further heating, then this is treated with other vegetable materials so that a liquid preparation is obtained.^b Of three varieties of this the best can be taken internally, the second best can be used to turn copper into gold by projection (*kho tien thung chheng chin*²), and the third can change silver into gold (*kho pien yin chheng chin*³). This must mean respectively (a) making golden-looking arsenical copper,^c and (b) depositing a yellow sulphide film on a silvery metal surface. The same book speaks of orpiment (arsenic trisulphide) in a parallel way, but omitting the plant materials and using words which suggest the heating of the sulphide to a fused matte (under conditions preventing oxidation);^d this can then be used to turn silver into gold (*tien yin chheng chin*⁴) and copper into silver (*tien thung chheng yin*⁵), both by projection. *Tien* in the former phrase is probably an error for *pien*, so again we would have (a) the deposition of a sulphide film, and (b) the making of a silvery arsenical copper.

Other fairly explicit texts are not too difficult to find. For example, the *Thai-Ku Thu Tui Ching*⁶ (Most Ancient Canon of the Element Earth and the *kua* Tui) says:^e

Furthermore, if one has metals some of which are not genuine, simply throw sal ammoniac upon them, and one will be able to distinguish the true from the imitation. A bath of sal ammoniac also makes colours uniform. Dragon's blood^f is able to protect colours from changing. Similarly, millet wine can soften metal (surfaces), *chih tsu*⁷ seeds^g can tint them, and an extract of *yü kan tsu*⁸ fruits^h can get rid of places which are not clean and shining. Red ochre (iron oxide) can both improve colours and beautify the substance; yellow alum (*huang fan*⁹) can bring out the tincture of all metals and minerals.

Here the writer is evidently speaking about tinted surface-layers on metals. Ammonium chloride is still today used for protecting metals from oxidation during soldering, the oxides being volatilised as chlorides, so its effect upon oxide surface tints would be conspicuous. A film of resin would conserve a surface colour, and the other plant substances mentioned were only a few among those which could exert an effect due to

^a As was suggested by Berthelot (1), p. 69.

^b Cit. *CLPT*, ch. 4, (p. 102.2).

^c Cf. p. 223 above.

^d Cit. *CLPT*, ch. 4, (p. 104.1).

^e *TT*942, ch. 3, p. 111a, b, tr. auct.

^f Presumably the resin from *Daemonorops draco* (cf. p. 171), a rattan.

^g This is *Gardenia florida* = *jasminoides* (R82; Anon. (57), vol. 2, no. 101, p. 403). The seeds have a yellow dye, hence the name Chinese yellowberry.

^h This is more usually called *an mo lê*,¹⁰ *Phyllanthus Emblica* = *E. officinalis* (R330). The fruits are known as myrobalans.

¹ 寶藏論

² 可點銅成金

³ 可變銀成金

⁴ 點銀成金

⁵ 點銅成銀

⁶ 太古土兌經

⁷ 梔子

⁸ 餘甘子

⁹ 黃礬

¹⁰ 菴摩勒

organic acids, dyes or S-compounds contained in them. One curious technical term clearly applying to surface-layer tints is *yün*,¹ 'halo'. We shall encounter it later on in a text of about +1045, the *Lu Huo Pên Tshao* of Tshui Fang (pt. 3), where saltpetre (potassium nitrate) is said to remove it. And the *Lung Hu Huan Tan Chüeh*² (Explanation of the Dragon-and-Tiger Cyclically Transformed Elixir), a Wu Tai or early Sung text, says that *yün*,¹ haloes, can be removed by a bath of the urine of brewers.³ This could hardly be due to any special constituent such as acetaldehyde, for probably any urine would have done as well, the ammonia formed in decomposition being no doubt the agent really concerned.

(iv) 'Purple sheen gold' and shakudō

It is possible to follow out one example of 'tingeing' in Chinese civilisation from quite early times in fascinating detail. It will be remembered from p. 50 above that the first scholar to occupy himself with the excavated gold coinage pieces of the State of Chhu was Shen Kua about +1080, and it will also be remembered that one of the forms of artificial gold named by Ko Hung about +320 was 'purple sheen gold of superior hue' (p. 70). Reading further in the same passage of the *Mêng Chhi Pi Than*, we come upon a remarkable account which opens up a whole vista on this purple sheen gold (*tsu mo chin*³), and suggests what it really was. After discussing the punch-marked gold coins, dating (as we now know) from the -5th to the -3rd centuries, Shen Kua goes on to say:^b

Furthermore, at a place called Pai-shui, near old Chhing-ling, between Hsiang (-chou) and Sui (-chou), excavation has yielded many gold 'unicorn-foot Pegasus-hoof' pieces (*chín lin chih niao thi*).^c These 'unicorn-foot' pieces are hollow at the centre, with very fine markings on the four sides (like) extremely skilled carvings. The 'horse-hoof' would have been used to make the shape of the little round cake-like lump. Yet since there are no traces of a mould on the four sides, it looks as if molten metal had been just dropped on a flat surface (and solidified, like drop-scones). Also such pieces have the appearance of dried persimmons (*shih*)^d—hence the local people call them 'persimmon gold' (*shih tsu chin*⁶).

Now the *Chao Fei-Yen Wai Chuan*⁷ (Unofficial Biography of Chao Fei-Yen) tells how the emperor (Han Chhêng Ti) secretly watched Chao Chao-I while she was in the bath, and (for this purpose) used to favour her attendants and private serving-maids with gold cakes (*chín ping*⁸). Those were probably of the same kind as these 'unicorn-foot Pegasus-hoof' pieces. Each of them weighs just over four ounces, the equivalent of one ancient catty (*chin*⁹). Their colour is a beautiful pinkish-purple (*tsu yen*¹⁰), with which no other gold can compare. This 'gold' is softer than lead, and even the large pieces can be cut with a knife. The centres are quite weak and soft, and can easily be ground to powder when submitted to the grindstone.^e

^a TT902, ch. 2, p. 30b.

^b MCPT, ch. 21, pp. 4b ff. para. 10, cf. Hu Tao-Ching (1), vol. 2, pp. 680ff., tr. auct.

^c The explanation of this curious name is reserved for a page or two, see p. 259.

^d *Diospyros kaki*, R188; CC481.

^e These properties must have been due to internal decay, probably grain-boundary corrosion, as we shall see. It is remarkable that the patina was unaffected.

¹ 暈

⁶ 柚子金

² 龍虎渡丹訣

⁷ 趙飛燕外傳

³ 紫磨金

⁸ 金餅

⁴ 金麟趾裏藏

⁹ 斤

⁵ 柿

¹⁰ 紫黯

According to the writers of miscellanies, these 'unicorn-foot Pegasus-hoof' pieces are the alchemical gold (*yao chin*¹) made formerly by Lou Ching.² Pharmacists (or, Taoist technicians) (*fang shih*³) call this 'Lou gold' (*Lou chin*⁴), and say that it is the best of all for compounding in medicines. The commentary of the *Chhien Han Shu* also says that it is 'different from all other gold (*i yü tha chin*⁵)'.^a When I once stayed for a year in Hantung^b several families got hold of some. There was one underground storage vault which had several dozens of these (gold) pieces in it, so I also was able to obtain one.^c

From this it is clear that Shen Kua was actually able to handle and study some of the pieces of a gold alloy with a purplish surface-film which he identified with the 'unicorn-foot Pegasus-hoof' pieces of Han Wu Ti, and thought might have been similar to the 'gold cakes' given as presents on a famous occasion by Han Chhêng Ti. Moreover, the significance will not be lost on us that Shen Kua regarded the purple sheen gold as Lou Ching's alchemical gold, just as the local countryfolk had attributed the coins of Chhu to the alchemical activities of Liu An. While they were wrong, we shall see that he was probably right. We can now unravel the background of his statements in two ways, first with regard to the 'unicorn-foot Pegasus-hoof' pieces, and secondly with regard to the Chao sisters at a subsequent court. The former line takes us back to the -2nd century, the latter to the -1st.

In the annals of the emperor Han Wu Ti (r. -140 to -86), that great patron of Taoists and alchemists (see pt. 3 below), there are two passages of much interest here. In -105 an edict said:^d

After We had performed the rites to Mt Shou, the fields at its foot produced precious things which metamorphosed, some becoming yellow gold (*thien chhu chen wu hua, huo wei huang chin*⁶), and when We sacrificed to the god of Earth three flames of supernatural light appeared. . . .

An amnesty and a general almsgiving were accordingly decreed. This did not escape the notice of Dubs, who rightly looked upon it as suspicious of some kind of aurifaction, but did not feel able to interpret it further.^e The presence of the 'supernatural flames' certainly suggests the presence of Taoist alchemists somewhere in the background. Then in -95 there was another edict, to the following effect:^f

After We had made the sacrifice outside the gates. . . and ascended Mt Lung-shou. . . yellow gold was discovered at Mt Thai (and other good omens were reported). Now therefore, in order to accord with these auspicious presages, we change the (customary bars of) yellow gold to 'unicorn-foot Pegasus-hoof' (pieces). Let them be distributed according to rank among the vassal lords and princes.

The commentators explain. Ying Shao (c. +180) says that it was the shape of the ingots that was changed, and tells us that the name was derived from a wonderful

^a Not in the editions we use, but it would support the view of Liu Pin (opp. page).

^b Mod. Suihsien in Hupei.

^c Most of this information was repeated in the mid +12th-century *Hsü Po Wu Chih*, ch. 10, p. 8a.

^d *Chhien Han Shu*, ch. 6, p. 26b, tr. auct., adjuv. Dubs (2), vol. 2, p. 97.

^e (5), p. 74.

^f *CHS*, ch. 6, p. 31a, tr. auct., adjuv. Dubs (2), vol. 2, p. 110.

¹ 藥金

² 異敬

³ 方士

⁴ 異金

⁵ 異於他金

⁶ 田出珍物化或爲黃金

legendary horse, Yao-Niao,¹ which could fly over 15,000 *li* of ground in a single day.² According to Yen Shih-Ku (c. +635) 'this means that although anciently gold was counted in terms of its weight in catties (pounds) and taels (ounces),^b it came in regular shapes laid down by official regulations, like the present gold ingots with luck-bringing inscriptions. . . .^c Nowadays people occasionally find gold horse-hoof ingots (*mathichin*²) in the ground;^d the metal of these is very fine and good, and in shape they are beautiful castings.' Later on, Liu Pin (c. +1070), for his part, believed (though perhaps more on philological than chemical grounds) that it was the 'transformed' gold from -105 that was used for this issue of Pegasus-hoof gold pieces. Such doctored gold would agree with what Shen Kua actually found. There is no corroborative evidence that Lou Ching, an adventurer and high military and civil official in the days of Han Kao Tsu (fl. -210 to -190),^e had any hand in making alchemical or aurifactive gold, but the tradition need not be wrong, since (as we shall see) the situation which led to the 'anti-coining' edict of -144 (p. 12, and pt. 3) had roots going back quite as far as this, and in between came the decades of activity of Liu An, Prince of Huai-nan, who was undoubtedly the patron of an important school of alchemists (cf. pt. 3 below).

About the 'horse-hoof ingots' some confusion grew up in the literature, later writers often taking them to be natural mined nuggets, but the best view is that they were standard-sized pieces of an alloy of gold.^f The *Pao Tsang Lun*³ (Discourse on the Contents of the Precious Treasury of the Earth), perhaps partly a Thang work,^g but certainly completed not later than +918, regards *ma thi chin*² as the best of all golds, and says that two standard pieces weigh one catty;^h it cannot therefore have been unworked natural gold.ⁱ Other texts repeat the information about weight. Furthermore it seems sometimes not to have been rich in gold at all. Khang Phien,⁴ writing about

^a This explains the use of the name Pegasus in the translation, but it should be added that the 'unicorn' or *chhi-lin*,⁵ a mythical animal, was supposed to have hoofs like the horse. Cf. *Shih Ching*, 1 (1), xi; Legge (8), vol. 1, p. 19.

^b Not exactly equivalent of course. In Yen's time the catty was equivalent to 1.32 lb avoirdupois, and there were always 16 oz in it.

^c Nothing else is now known about these.

^d And they still do, for in 1962 Chieh Hsi-Kung (1) reported the discovery of five pieces of unicorn-foot horse-hoof gold in excavations at Tung-thai-pao Village near Taiyuan in Shansi. We reproduce his photograph in Fig. 1327. The concavo-convex cakes weigh 5 oz each or just under, and most bear fragmentary inscriptions in almost illegible characters. Judging by the datings of other objects in the same finds, these pieces must belong to -95 or soon after and in any case before -74.

^e By a change of family name due to imperial favour he became Liu Ching.⁶

^f Analyses of the recent finds have not yet appeared. On this, and other subjects discussed in these paragraphs, the best study has been that of Chang Hung-Chao (1), pp. 361 ff., reproduced, in abridged form, in Hu Tao-Ching (1), vol. 2, pp. 681 ff.

^g I.e. in our view, but Chang Tzu-Kao (2), p. 118, puts it all as late as Wu Tai (first half of the +10th century, rather than from the +8th onwards). It is a work of great value (cf. p. 273 below), but now extant only in quotations.

^h Cit. *PTKM*, ch. 8, (p. 3).

ⁱ As was later supposed by Ku Thai⁷ in his *Po Wu Yao Lan*⁸ (Principal Points about Objects of Art and Nature), c. +1560, and by Fang I-Chih in *Wu Li Hsiao Shih* (+1664), ch. 7, p. 1 a. Following this, Yang Lien-Sheng (3), p. 46, still gives *ma thi chin* as one of the names for natural gold.

¹ 驪黃

² 馬蹄金

³ 寶藏論

⁴ 康駢

⁵ 麒麟

⁶ 劉敬

⁷ 谷泰

⁸ 博物要覽

+885 in his *Chi Than Lu*,¹ tells a story of a man who found a buried jar of *ma thi chin* pieces, but they quickly corroded and decayed, presumably on exposure to the air.² A law case was involved, the decision in which partly depended on filling the jar with real gold ingots and showing that the coolie could not even have lifted it to carry. This shows that the high specific weight of elementary gold was well known at the time, and that the *ma thi chin*² was a lighter alloy.

So much for the 'horsey' side of the matter. We can now turn back to the other episode of Han times and enquire who was Chao Fei-Yen, the 'Flying Swallow'. About the year -24 two young sisters came to the capital, Chhang-an, to make their fortune, though well endowed in one way they were already, since before long generally recognised as the greatest beauties of their time. They must also have been intelligent, for their biographer says^b that in the home of their late father, Fêng Wan-Chin,³ who had been a musician at a princely court, they had studied books on medicine (especially sphygmology) and on Taoist physiological alchemy (including respiratory exercises, gymnastics and sexual techniques). The elder, Chao I-Chu,⁴ won fame as an outstandingly graceful dancer, hence the name 'flying swallow', while the younger, Chao Chao-I,⁵ was a singer and story-teller. By -18 both had been incorporated among the ladies of the imperial court, and there the elder quickly became the favourite concubine of Han Chhêng Ti, who two years later made her empress. He was also greatly in love, however, with the younger sister, Chao-I, and this was how the story originated of the purple sheen gold which he gave to her attendants in order to be able to look upon her in the bath. In Ling Hsüan's biography as we have it now one cannot find any statement about these gifts other than that they were ordinary 'yellow gold',^c but he does mention in another place that among the gifts which passed between the sisters there were three censers of purple gold (*tsu chin*)⁶ for use among the bedclothes; these were evidently of the type with gimbals associated with the name of the inventor Ting Huan.⁷ Alas, it all ended tragically, the young emperor died in -7, not without recourse, it is said, to dangerous aphrodisiac elixirs,^e and in the ensuing palace upheaval the Chao sisters were driven to suicide.^f But they were lovely and pleasant in their lives,^g and their memorial lightens the pages of chemical and metal history. Something to retain from this, at any rate, is that purple gold was probably the same thing as purple sheen gold.

^a The story is found only in the fullest versions of the book.

^b Ling Hsüan,⁸ in the *Chao Fei-Yen Wai Chuan*, which purports to be a Han text, if so, of the +1st century. It occurs in several collections, e.g. *SF*, ch. 32, p. 20b, and has been translated by Lin Yü-Thang (8), pp. 378ff., and Eichhorn (11).

^c *Loc. cit.* p. 24a.

^d See Vol. 4, pt. 2, p. 233. *Loc. cit.* p. 22b.

^e This was of course the stock ending, found e.g. in the historical novels written about Han Chhêng Ti and the Chao sisters, such as the *Chao Fei-Yen Pieh Chuan*⁹ written in the Sung by Chhin Shun,¹⁰ cf. *SF*, ch. 32, p. 28a. On this see Eichhorn (11).

^f Chao-I in -6 and her elder sister in -1.

^g Up to a point, that is, for Chao-I was accused of having done away with the emperor's baby sons by other palace ladies, and the case was regarded as proved (see the texts translated by Wilbur (1), pp. 418ff., 424ff.).

¹ 劇談錄

² 馬鬣金

³ 馮萬金

⁴ 趙宜主

⁵ 趙昭儀

⁶ 紫金

⁷ 丁緩

⁸ 伶玄

⁹ 趙飛燕別傳

¹⁰ 秦醇

Elsewhere both terms appear in important places. The *Erh Ya* dictionary dates from the -4th century, but Kuo Pho's commentary on it from the +3rd. From p. 54 above it will be remembered that the text itself tells how the old name for gold was *thang*¹ (using the jade radical because it was pale like jade, so perhaps it was often *electrum*), while the best gold was called *lu* (*chhi mei ché wei chih lu*²). Then, hundreds of years later, Kuo Pho adds: 'and this *lu* is the same as *tsu mo chin*³ (purple sheen gold)'.⁴ As we shall see, he was probably mistaken in this, but the intriguing problem remains why at such an early date the purple or violet colour should have been so much prized in China, exactly as among the Hellenistic aurifactors. Others had the same preference, for example, Khung Jung⁴ (d. c. +208) wrote that 'the best gold is called purple sheen gold, (as much above other sorts) as the sage is, compared with the people'.⁵ This would have been some seventy years before Kuo Pho's remark, but parallel statements are common later. The *Shui Ching Chu*⁵ (c. +500) says that 'the common people call the best gold *tsu mo* (purple sheen), the barbarians call it *yang mai*⁶'.⁷ While one Thang alchemical text speaks of the result of a process as 'pure-coloured gold' (*tsu sé chin*⁷),⁸ another calls its product 'best red purple-sheen yellow gold' (*chhih shang sé tsu mo huang chin*⁸).⁹ So also a treatise of about +712, of much importance theoretically (cf. pt. 4), has a colour sequence of artificial golds which ends in purple.¹⁰ After the third transformation, virid gold granules (*chhing chin sha*⁹) are produced, after the fourth, yellow gold (*huang chin*¹⁰), after the fifth and sixth, red and scarlet gold respectively (*hung chin*¹¹, *chhih chin*¹²), and finally, after the seventh, purple gold (*tsu chin*¹³). All through the intervening centuries translators putting Buddhist sūtras into Chinese had made free use of 'purple sheen gold' among the embellishments of paradise and its Buddhas.¹⁴ There was also a tradition that it was plentiful in Persia and other Western countries, and that at one time it had been imported from such places,¹⁵ and just as in the case of the 'unicorn-foot' or 'horse-hoof' gold lumps a parallel aberrant tradition that purple sheen gold was a natural mined product.¹⁶

¹ Ch. 6, p. 6a.

² CSHK (Hou Han sect.), ch. 83, p. 10b.

³ Ch. 36, p. 22a (Wên Shui sect.). The statement is repeated exactly, c. +670, in the chapter on Lin-I (part of mod. Vietnam) in the *Nan Shih*, ch. 78, p. 3a.

⁴ TT903, pp. 10b, 13a.

⁵ TT879, p. 6a.

⁶ TT883, in YCCC, ch. 69, p. 3a, tr. Sivin (4), the colour sequence reported in (2).

⁷ This happened from the time of An Shih-Kao in the late +2nd century onwards. Many examples are given in the relevant entry in Chang Hung-Chao (1), pp. 330ff. He suggests that it may have been the standard translation of *jambūnada suvarṇa*, 'the gold of the Jambu River'. See further Chang Hung-Chao (8), pp. 42-3, 111ff., criticising Laufer (1), pp. 509-10.

⁸ The *Liu Thieh*¹⁴ (Six Slips) examination encyclopaedia (c. +800) says that the country of Po-Lu,¹⁵ i.e. Bolur, or Hunza-Nagar, south-east of the Pamirs, a region famous for its minerals, was rich in purple gold. The *Pao Tsang Lun*, also in the Thang, says: 'Persia used to export it, but we cannot find out much about that now. My belief is that it was really produced in India, but as people of former times got it from Persia they thought it actually originated from there.' See PTKM, ch. 8, (p. 4) and Chang Hung-Chao, *loc. cit.*

⁹ E.g. *Thai-Phing Huan Yü Chi* (c. +980), saying that at Lo-thing Shih in Lu-ling Hsien, where there is 'magic-mushroom herb' growing above, purple gold is found beneath. On geobotanical prospecting in medieval China cf. Vol. 3, pp. 675ff.

¹ 璽

² 其美者謂之璽

³ 紫磨金

⁴ 孔融

⁵ 水經注

⁶ 陽邁

⁷ 足色金

⁸ 赤上色紫磨黃金

⁹ 膏金砂

¹⁰ 黃金

¹¹ 紅金

¹² 赤金

¹³ 紫金

¹⁴ 六帖

¹⁵ 鉢露

When one looks at all this evidence together it presents a rather clear picture of the continuing use of a particular alloy over many centuries. It may well have been first found out by Lou Ching and then made use of on a large scale by Han Wu Ti, who would doubtless have appreciated the economy it meant in the use of bullion. What the alloy was is not (if we are on the right track) difficult to say. 'Purple sheen gold' is quite easy to make, and well known to the 'bronzers', as those who 'tinge' and colour metal surfaces in modern times are called. If an alloy of much copper and little gold (about 4%) is treated with copper acetate, acetic acid and copper sulphate, beautiful permanent tints of rich purple or violet are produced.^a The conclusion is that Kuo Pho in the +3rd century, seduced by his warm admiration for the purple-surfaced alloy, made a mistake, and so led the way for many others later on to confuse the best gold with a cunningly contrived but beautiful 'tinged' debasement of gold.^b This leaves us with two points, how was it that purple became such an admired colour in China, and secondly what connection could this have had with the *iōsis* so beloved of the Hellenistic philosophical-mystical aurifactors?

All through the medieval period, purple was one of the most characteristic colours of religious Taoism. It signified lofty empyreal abstraction, like the mystery of dawn and sunset clouds. Unlike the Mediterranean region with its *Murex* and its senatorial or imperial purple,^c this colour in China had never been that of kingship, nor was it among the anciently allotted colours of the five directions of space; what it belonged to was Taoist adeptship and the alchemy connected with it. This comes out again and again in Taoist *hao* or adopted personal names or sobriquets. Tzu Hsü Chen-Jen,¹ the Adept of the Purple Emptiness, was Tshui Chia-Yen, a Taoist physician famous in sphygmology (*fl.* +1170 to +1190). Tzu Chhiung Chen-Jen,² the Purple-Jasper Adept, was Chang Mu, a +13th-century Taoist astronomer and alchemist, the teacher of Chao Yu-Chhün. Or, to take one further example, the Great Immortal of the Purple Gold Splendour (Tzu Chin Kuang Yao Ta Hsien³) was none other than Têng Hsi-Hsien, a Taoist sexologist of the +16th century. Ho Wei⁴ in his *Chhun Chu Chi Wên*⁵ recorded, about +1095, as a particularly prestigious case of alchemical operations, the work of a monk Fa-Khung⁶ and an abbot Wu-Hsiang⁷ who succeeded in preparing a soft alloy of some kind which the goldsmiths were interested to buy, and which gave off purple vapour when heated in the furnace.^d Perhaps they were seeing potassium flames. Earlier, a Thang text, the *Hsüan Shih Chih*⁸ of Chang Tu,⁹

^a Hopkins (3), based on Hiorns (1), pp. 108, 152. Cf. Hopkins (1), pp. vii, 100. Copper alone, without the gold, is turned a brownish-red by this pickle. Iron plated with copper, or with the copper-gold alloy, will also sustain the same effects.

^b 'Purple gold' still goes on. My old friend Li Shu-Hua (3), p. 66, visiting Kao-Ming Ssu¹⁰ (temple) on Thien-thai Shan¹¹ in Chekiang in 1936, was shown among other treasures a basin of purple gold about a foot across; the metal seemed to be a copper alloy or bronze, apart from the colour.

^c All students of Hellenistic proto-chemistry emphasise the association with the art of the textile dyer. In China this seems not to be so evident.

^d Ch. 10, pp. 3a, 4b. We draw more from this interesting book elsewhere (p. 233 and pt. 3).

¹ 紫虛真人

² 紫瓊真人

³ 紫金光耀大仙

⁴ 何薏

⁵ 春渚紀聞

⁶ 法空

⁷ 無相

⁸ 宣室志

⁹ 張讀

¹⁰ 高明寺

¹¹ 天臺山

c. +860, tells how when Wei Ssu-Hsüan¹ was searching out techniques of refining gold he once entertained a strange guest, one Hsin Jui,² who suffered from severe bleeding and intractable carbuncles, sure signs of advanced elixir poisoning.³ After he left, his urine was found to be a brightly shining purple-gold liquid, with I know not what remarkable properties. Stories of this kind need not make sense, what they witness to for us is the enthusiasm for purple as the colour of Taoist mystery.

At times this colour term was also applied to grades of what must have been high-carat gold. In the late +13th century the *Kuei Hsin Tsa Chih* says that nugget gold comes from mines in Kuangsi; some in broken grains resembling earthworm excreta (*chhiu-yin ni*³), some the size of melon-seeds (*kua tzu chin*⁴),^b some in small broken pieces like oatmeal flakes (*fu phi chin*⁵). 'These last have a deep purple colour, and are the best of all gold, hence the government lists have grade entries for gold, purplish (*chin tzu*⁶) and silver, caerulean (*yin chhing*⁷).'^c In +1387 the *Ko Ku Yao Lun* says that 'when mixed with copper, there are grades of colours, gold 7 parts (in 10) is caerulean, 8 parts (in 10) is yellow, 9 parts (in 10) is purple, and gold with no copper is red; this is "full colour gold". Such gold has marks like pepper flowers or phoenix tails, and a colour like purple clouds (*tzu hsia*⁸).'^d By this time, however, the skill of the touchstone had come to China, so some of the colours may have referred to those produced on that.^e The same book has an interesting statement about a Chiangsu man named Thang Tsung-Jen⁹ who made himself famous at the capital for jewellery of reddish 'full-colour' gold with purple patches; this *tzu i*¹⁰ was very popular and sold at high prices.^f And Tshao Chao goes on to give the game away by saying that formerly the half-liang coins used to be of purple gold, but nowadays people take copper (*chhih thung*¹¹) and mix it with yellow gold to make the purple-surfaced alloy, so that one never sees the 'real purple gold' of the good old days.^g Obviously Thang Tsung-Jen was using the 'bronzing' procedure already described. In the +16th century Tshao Chao's successor Ku Thai denoted another sort of gold, 'olive gold' (*kan-lan chin*¹²), reddish-purple in colour, which again probably indicates a treated surface (*Po Wu Yao Lan*). Finally Chang Hung-Chao found significant place-names in the *Fang Yü Chi*¹³ (c + 5th cent.), notably a Tzu-chin Shan¹⁴ mountain in Phing-yang Fu in Shansi where a good deal of copper was mined;^h the more famous hills of the same name near Nanking may also have produced this metal. This bears out the general interpretation at which we have arrived.

As for the extraordinary coincidence of the association of a purple colour with the highest level of the aurifactive art in China as well as in Hellenistic Egypt—if coinci-

^a Cf. Ho Ping-Yü & Needham (4), and further in Sect. 45 below.

^b Cf. Yang Lien-Sheng (3), p. 46.

^c *Hsin Chih*, ch. 1, p. 40a, tr. auct.

^d Ch. 6, p. 12a, tr. auct.

^e See Vol. 3, p. 672.

^f Cf. the comments of Yang Lieh-Yü (1), p. 83.

^g Ch. 6, p. 12a, b. Cf. David (3), pp. 134-5, on both passages.

^h Chang Hung-Chao (1), p. 333. But not every mountain of this name yielded the metal; cf. the account of another, also in Shansi, by Norin (1).

¹ 韋思玄

² 辛銳

³ 蚯蚓泥

⁴ 瓜子金

⁵ 鉄皮金

⁶ 金紫

⁷ 銀青

⁸ 紫霞

⁹ 唐宗仁

¹⁰ 紫衣

¹¹ 赤銅

¹² 橄欖金

¹³ 方輿記

¹⁴ 紫金山

dence it is—we must postpone comment upon it until the sub-section on parallelisms and transmissions between the two most ancient culture-areas of proto-chemistry. It does seem remarkable that the *iōsis* or purpling (cf. p. 23 above) of the Graeco-Egyptians should be mirrored in the activities of Lou Ching (contemporary of Bolus of Mendes) and the back-room aurifactors or aurifictors of Han Wu Ti, and all those others who evoked the comments of Khung Jung and Kuo Pho about the time of Pseudo-Democritus and before Zosimus of Panopolis. But we cannot see this in its proper perspective until we look at the whole parallelism of the spagyric art in the ancient civilisations (pt. 4).

If we have been on the right track about 'purple gold' in ancient and medieval China one might expect to find some survivals somewhere in the cultures of East Asia. In fact this turns out to be so, in Japan, where so many other inventions and discoveries of old China were preserved and developed.^a A century ago Europeans were much impressed by a Japanese alloy called *shakudō*^{1,2}, which Gowland (6, 12) and Roberts-Austen (2)^c found to consist of about 95 % copper with c. 1 % silver and 1 to 5 % gold, i.e. just the proportions we have assumed for 'purple sheen gold'. Upon treatment with solutions of copper acetate, copper sulphate and acetic acid, sometimes with the addition of sodium chloride, potassium nitrate and sulphur, a 'beautiful rich purple coat or patina' (film) is produced on the metal surface.^d A second alloy, known as *shibu-ichi*³ or *oboro-shirogane*⁴,^e was found by Gowland, Roberts-Austen and others to be composed of almost equal parts of copper and silver (the former tending to predominate), with only 0.1 % gold, 0.5 % iron and sometimes a little lead. As Gowland remarked, there is nothing especially beautiful in the alloys themselves as simply cast; their value as decorative metals is entirely dependent on the patinas which can be produced on their surfaces by suitable treatment. Before this, *shakudō* is of an uninteresting dark copper colour, but when completely pickled it acquires a rich black surface with a violet sheen 'unapproached in the beauty of its patina by any other alloy', and most suitable for the inlay of gold, silver and copper; moreover it has excellent casting and deformation characteristics. 'The object', wrote Gowland, in his eye-witness account, 'is first boiled in a lye prepared by lixiviating wood ashes,^f after which it is carefully polished, if necessary, with powdered charcoal. It is then immersed in plum vinegar containing

^a Cases of this can be found both in ceramics and textile technology, while an example closely relevant here is that of pattern-welding in steel sabres; see Sect. 36, and meanwhile Needham (32).

^b I.e. 'red bronze' or 'black gold', Cf. Table 96.

^c Followed by Hiorns (1), pp. 151 ff., 226 ff., (2), pp. 289 ff.; Hiscox (1), p. 69.

^d Copper acetate, sulphate and acetic acid alone are sufficient for the purpling effect on *shakudō*, but they turn copper a dull or brownish-red (Roberts-Austen). Brass goes umber-brown with a greenish sheen, then darkens to grey 'inclining to purple'. With the nitrate but without the salt and acetic acid brass can be given a purplish stain, and with nitrate and salt without the acetic acid copper goes black; but the two copper salts must always be present. Alone, they turn copper light brown and brass umber-brown with a bluish sheen (Hiorns).

^e I.e. 'quarter-metal' and 'hazy silver' respectively. The former term refers properly to the presence of one part of silver to three of copper, but the alloy was often much richer in silver than that, for the best patina is only so attained.

^f I.e. concentrated potassium hydroxide solution.

¹ 赤銅

² 烏金

³ 四分一

⁴ 靚銀

common salt in solution, and after being washed with a weak lye, is placed in a tub of water to remove all traces of alkali. After this treatment it is digested in a boiling solution of copper sulphate, verdigris, and water, to which potassium nitrate is sometimes added, until the desired patina is produced.¹ *Shibu-ichi* was treated, Gowland found, in just the same way; a dull gun-metal colour to begin with,² it assumes a patina of charming shades of grey, also very well fitted for the inlay of gold or silver.³ The two alloys were sometimes themselves alloyed, so that *kyū-shibu-ichi*,¹ for instance, consisted of one part of *shakudō* to two parts of *shibu-ichi*. Also on occasion they were more cleverly combined, as in *mokume*² work,^c with other metals of different colours, especially gold, silver, and *kuromi*³ alloy (copper, tin and cobalt); multiple layers being forged, sweated or soldered together, and then punched out in repoussé fashion or elsewhere filed or chiselled so as to produce flat relief designs in contrasting colours.^d

The history of *shakudō* and *shibu-ichi* in Japan is not very clear; there are stories of large cast images made of the former at Nara and referred to the +7th century,^e but more conservative accounts find it first in extant sword-guards of the mid +14th century (as also *shibu-ichi*), and one reliquary of the Buddhist abbot Nichiren is certainly made of *shakudō* (c. +1580).^f Hints exist, moreover, pointing (as one would expect) to a Chinese origin, for a French diplomat, Maurice Paléologue, gave a rather garbled account of an alloy of copper and tin containing small amounts of gold in use in China in his time for making vases and vessels the beauty of which depended on the patina they acquired by a 'bronzing dip'.^g Since this consisted, *inter alia*, of copper acetate and strong vinegar made from plums, the resemblance to the Japanese technique is distinctly suspicious.^h Indeed, the case is as good as proved by the fact that about +640 Sun Ssu-Mo included in his *Tan Ching Yao Chüeh* a 'plum bath' (*mei chüeh*⁴) or quenching dip, expressly for metals.¹ Made from unripe *Prunus mume*, it would have contained a strong mixture of malic, oxalic and other organic acids, if not acetic, in brine.

Secondly, Western collections of workshop recipes contain a traditional 'Chinese method' for giving a bronze colour to copper, the object being treated with a mixture of copper acetate, cinnabar, sal ammoniac and alum, made into a paste with vinegar.

^a Apparently it was also sometimes used for getting a silver surface-layer by a form of cementation.

^b The same 'tingeing', 'pickling', 'bronzing' or 'dipping' process (with a slightly stronger acetic acid solution) was also used in Japan for giving a fine grey patina to bronze containing up to 2% As and smaller amounts of Sb. In more recent times Japanese metallurgists have succeeded in producing the purple-black patina of *shakudō*, at any rate to some extent, without the use of Au, by adding a speiss of Fe and As to ordinary bronze.

^c Lit. 'wood-grain'.

^d This was quite analogous to the age-old technique used for layers of different-coloured lacquers (cf. Sect. 42). Roberts-Austen illustrated (2) a beautiful knife-handle with a duck of purple *shakudō* on a grey ground of *shibu-ichi*.

^e Roberts-Austen (2).

^f Gowland (6), p. 91.

^g I could not find this in the obvious place, Paléologue (1), so it must have been in some periodical publication, but Gowland gives no exact reference.

^h It would be interesting to know if there are any examples of such work in museums.

¹ On this book see below, in pt. 3. The reference here is to *TT1020*, p. 26b, for the formula is omitted in the separate *YCCC* edition, probably as being purely metallurgical in interest.

The colour was said to be rendered darker if copper sulphate was also added, and yellower with borax. Hiorns could not succeed in making this work;^a while Hopkins, gallantly trying to interpret a Chinese empirical formula in the light of the Hellenistic papyri (without knowing any Chinese),^b suggested that alum really meant red iron oxide, and sal ammoniac soda or borax. His experiments with this gave to sheet copper 'a beautiful reddish-pink colour with wavy greenish lines'. But since his attempted corrections were inadmissible sinologically, what happened did not matter much anyway, and the only thing we need to retain from this episode is that it suggests there were indeed 'bronzing recipes' (often perhaps family secrets) in traditional China.

A text from the Sung which shows just this is to be found in the *Lao Hsiieh An Pi Chi*¹ (Notes from the Hall of Learned Old Age). About +1190 Lu Yu² wrote:^c

The colour of bronze was originally yellow. Bells, tripod-cauldrons and other vessels made in olden times were generally of yellow bronze (*huang thung*,³ i.e. brass).

But nowadays as men get them by excavation from the earth (i.e. from tombs) they have a (dark) colour due to their long stay underground; this is only natural.

That is no reason, however, why vessels made for modern temples should have to be tinged a brownish-black by the aid of chemicals (*i yao chih jan ling tshang hei*⁴).

From this it seems clear that a great deal of brass was used in Lu Yu's time, and that much of it, especially vessels intended for temples and ancestral altars, was artificially 'bronzed'. He himself was considerably more familiar with brass than with bronze, and gained the impression that the ancient bronzes had also been brass once, before the centuries of burial conferred a dark patina on them; what he objected to was the attempt to disguise brass by 'tingeing' and (as he literally says) 'dyeing'. Later, in the +14th century, the *Ko Ku Yao Lun* has a good deal on the natural colours of ancient bronze (*ku thung se*⁵) and the green patina it can acquire, as also on the various methods for fraudulently reproducing this (*wei ku thung*⁶).^d Finally, the Jesuit P. M. Cibot in +1779 published a traditional Chinese formula current in his time for the bronzing of copper (17). After washing the object with ashes and vinegar, it was repeatedly covered with a paste of verdigris, cinnabar, sal ammoniac, alum, and dried powdered bird tissues as a source of carbon, then baked, washed, covered and baked again. In sum, there are good reasons for visualising a long history of 'bronzing' and 'pickling' in China, with the production of surface films of many colours.

^a (1), pp. 104ff. His book, however, is full of processes which do give a bronze colour to copper and brass very effectively.

^b (3), p. 50. He assumed of course that anything the Chinese and Japanese could do successfully in this line owed its origin to 'Egyptian alchemy'. How extremely dubious any such assumption must be will be evident from parts 3 and 4 of this volume.

^c Ch. 4, p. 10a, b, tr. auct., adjuv. Chang Hung-Chao (2), p. 22.

^d Ch. 6, pp. 16aff. Cf. David (3), pp. 9ff.

¹ 老學庵筆記

² 陸游

³ 黃銅

⁴ 以藥之染令蒼黑

⁵ 古銅色

⁶ 僞古銅

(7) VIOLET ALLOYS, 'PURPLE OF CASSIUS', RUBY GLASS, MOSAIC GOLD AND THE *PANACEA ANTIMONIALIS*

Having thus strayed away a little from 'purple sheen gold' it is instructive to come back to it briefly in order to take a look at what (presumably) it could not have been. One possibility which ought to be borne in mind is the curious purple or violet alloy of almost equal amounts of copper and antimony known as 'regulus of Venus'.^a Here everything depends on the question raised already (p. 189 above) whether we are justified in ruling out the use by the medieval Chinese alchemists of certain mineral substances which we know to be abundantly present in China, so much so as to be major items in world production today, but which, presumably because irrelevant in medicine, remained unmentioned, or almost so, in the literature of pharmaceutical natural history (*pên tshao*). Antimony is an outstanding case of this. In spite of the enormous deposits of stibnite (Sb_2S_3)^b at many places in Hunan, especially west and south-west of Chhangsha,^c no mention of antimony or its compounds occurs in the natural histories until +1590, when Li Shih-Chen lists *hsi lin chih*^{1,2} as 'a Persian silver ore' and seems to use it against trachoma, internally as an emetic, and in cases of infantile convulsions.^d This must refer to one of the well-known minerals which contain silver with antimony and sulphur.^e But it may be entirely wrong to attempt to judge of technical use by the *pên tshao* literature alone, and one must always remember that in the Taoist alchemical texts there are hundreds, even thousands, of names for substances not yet identified—to say nothing of substances which individual alchemists knew how to make use of.^f It seems almost more likely than not that Hunanese stibnite would have been one of these.^g For such reasons it might be wise not to

^a Roberts-Austen (2), pp. 1115, 1141; Hiorns (1), p. 14; Hiscox (1), p. 61. The alloy may be a chemical compound, SbCu_8 (Partington (10), p. 632). Its characteristic colour may be produced on coppered objects of iron or brass by dipping them for a short time in an appropriate antimonial solution.

^b And associated secondary minerals such as the oxides valentinite and cervantite.

^c See Liang (1); Wheler (1); Tegengren (2); Gowland (9), p. 441; Collins (1), pp. 94ff.; di Villa (1), pp. 71ff.; Bain (1), pp. 181ff.; Wang Chhung-Yu (2, 3); Torgashev (1), pp. 220ff.

^d *PTKM*, ch. 8, (p. 7); *RP* 3. Laufer (1), p. 509, cites medieval Arabic evidence suggesting Sb mines in Persia.

^e E.g. pyrrargyrite (Ag_3SbS_3 , 'ruby-silver'), stephanite (Ag_3SbS_4) or dyscrasite (Ag_3Sb); cf. Partington (10), p. 341; Gowland (9), p. 297. Proustite (Ag_3AsS_3) also is pale red. The *Shan Hai Ching* occasionally mentions *chih yin*,³ 'red silver'. Chang Hung-Chao (1), pp. 323ff., suggested that this might have referred to the colour of one or other of these ores, though he himself inclined to the view that it meant haematite (*ché*, *RP* 78). Yet the commentary of Kuo Pho (c. +300) says that '*chih yin* is the essence (*ching*) of silver', which rather indicates that in his time they were used for smelting that metal. There has been little modern report of their occurrence in China. Most Chinese silver comes from argentiferous galena (Torgashev (1), pp. 151ff.).

^f Stibnite may sometimes have hidden under the name *hei shih chih*,⁶ the black member of the 'five coloured clays' (*PTKM*, ch. 9, (p. 81), *RP* 57c), along with graphite, or so thought de Mély (1), pp. 88, 209.

^g It is curious that the eminent story of the black eyebrow-paint *al-kohl* (Ar. and Hebr.) seems not to have had any exact counterpart in China. What Jezebel's *stibio* (2 Kings ix. 30, cf. Ezek. xxiii. 40) really was we do not know, but it is equally sure that while ancient Egyptian eye-paint was mostly galena, lead sulphide (Lucas (1), pp. 99ff.), the Roman variety was *stimmis* or *stibi*, antimony sulphide (Pliny, *Nat. Hist.* xxxiii, xxxiii, 101-xxxiv, 104, cf. Bailey (1), vol. 1, p. 213). The use of this has continued in Arabic culture until now, the mineral being comminuted to a very fine powder—hence the transfer of the name

¹ 錫悞脂

² 悉蘭脂

³ 赤銀

⁴ 礬

⁵ 精

⁶ 黑石脂

exclude the possibility that 'purple sheen gold' (*tsu mo chin*) was in reality from the time of the Flying Swallow Empress onwards the copper-antimony alloy of equal parts, called (in this case most appropriately) after the metal sacred to the Cypriot goddess.

With other metals the degree of probability decreases. But in view of what was said above about aluminium it is just worth remembering that an alloy of gold with aluminium in the proportion 78:22 has an intensely purple colour and a scintillating appearance.^a Still, it is highly improbable that this could have been made in medieval China. And one can rule out even more certainly those brittle and easily fusible alloys of some 10 to 20% of platinum in bismuth which acquire purple or violet tints on contact with air.^b The pre-modern metallurgy of platinum, so far as it went, belonged to the New World rather than the Old (cf. p. 221 above).

We now have only two things to do before we can finish this part of the introduction designed to throw metallurgical light on the history of Chinese alchemy and early chemistry. The first is to mention one or two special cases of gold, silver or purple treasures not exactly free metals nor mixtures of them; and the second is to consider certain interesting medieval Chinese lists of artificial golds and silvers to see how many we can now, provisionally at least, identify.

Let us turn first then (still pursuing the purple thread) to that curious combination of tin and gold which is known as 'purple of Cassius'. Although it probably has little to do with East Asian medieval alchemy it does have an interesting connection with later Chinese technology. Gold in particles so fine as to form colloidal suspensions gives to these a fine ruby-red colour.^c When a solution of gold chloride is precipitated with stannous chloride, hydrochloric acid and stannic oxide are formed, and a purple powder is produced consisting of colloidal gold adsorbed on the colloidal oxide.^d When glass is fused with this 'purple of Cassius' it is colourless, but on annealing it assumes the familiar ruby colour because of the presence of the ultra-microscopic particles of gold.^e The powder got its name because traditionally first prepared by Andreas Cassius the elder (d. +1673), a friend of Joachim Jungius (cf. p. 24). He did not publish the process for 'praecipitatio Solis cum Jove', however, and the first to write about it was his pupil J. C. Orschall, in a tractate, *Sol sine Veste*, of +1684; this

by Paracelsus to our alcohol, 'rectified spirit of wine', *alcool vini* (*alcool est rei cuiuslibet subtilissimum*; cf. Partington (7), vol. 2, p. 149). In China, on the other hand, the most traditional eyebrow-paint (*hua mei sê*¹) was the stick of willow-twigg charcoal. Li Shih-Chen, however, *loc. cit.*, says that in the south the 'black coloured clay' was used; this *hua mei shih*² certainly included graphite (*shih mo*³) and just possibly stibnite. The ancient name of the 'eyebrow-mineral' was *tai*⁴ (*Shuo Wên*). The word antimony did not come in till the late +15th century; its etymology is disputed. Dioscorides (v, 59) probably knew the metal but mistook it for lead (cf. Dyson (1); Hoover & Hoover (1), pp. 428 ff.).

^a Hiorns (2), p. 373; Hiscox (1), p. 50.

^b Hiorns (2), p. 425.

^c Partington (10), pp. 84, 355. Colloidal gold was first thoroughly studied by Faraday in 1857.

^d Partington (10), pp. 355, 516; (7), vol. 3, pp. 643, 686. The reaction was clarified by Richter (1802), Proust (1806) and finally, following Faraday, by Moissan in 1905. Hiscox (1), p. 383, gives an example of modern workshop instructions for making pink and purple enamels with it.

^e This was first stated by de Blancourt (1), p. 177, in +1699, but must by then have been known in the trade for a couple of centuries.

¹ 畫眉石

² 畫眉石

³ 石墨

⁴ 黛

was followed a year later by a similar pamphlet due to Andreas Cassius the younger.^a One of the first to give a clear discussion of the whole subject of red (gold-ruby) glass was Johann Kunckel (d. +1703) in his posthumously published *Collegium Physico-Chemicum* of +1716.^b

But it seems that red glass made with gold had been known a long time before the work of this German group. Although the artist Antonio of Pisa in the late +14th century, like his predecessors Heraclius and Theophilus, knew mainly the brownish-red glass made with copper oxide,^c gold-ruby glass is certainly described in a mid +15th-century MS., the anonymous 'Segreti per Colori'.^d The artisans had in fact found out a way, almost as soon as *aqua regia* came in (early +14th century), of getting colloidal gold by the use of gold chloride made by dissolving the metal in the two acids.^e This process was clearly described in print by Antonio Neri in +1612,^f and may well have been used for translucent red enamels a century earlier, as by the adept whose work Benvenuto Cellini graphically described.^g Yet in spite of an ancient folk belief that gold could be got from stained-glass windows,^h no archaeological evidence for the use of gold-ruby glass in these before the +16th or +17th century has yet been found; probably expense forbade the use of gold.

Meanwhile a relation with East Asian technology was slowly arising, for it was in Antonio of Pisa's time that examples of cloisonné work from the Islamic culture-area began to arrive in China and to stimulate the development of the same technique there.ⁱ Enamels are only transparent, translucent or opaque glasses which when melted at suitably high temperatures adhere to a base of gold, silver or copper,^j being laid on in separate compartments so that they do not mix.^k The oldest account of cloisonné in China, that of the *Ko Ku Yao Lun* (+1387),^l does not say what colours were used, but extant pieces of the late Yuan and Ming periods show a brilliant variety.^m Then in the Chhing period these were supplemented by the colloidal gold purple of Europe in

^a Partington (7), vol. 2, pp. 370ff.

^b (2), p. 650.

^c See the translation of Bruck (1). Antonio of Pisa did know, however, of imported red glass from Germany or Holland, which may have been the 'gold-ruby' type. Copper was of course used in Chinese ceramic glazes also, but it has only one hundredth the strength of gold in producing red colours (cf. Mellor, 3).

^d As was first noted by Merrifield (1), pp. 277ff. Cf. Ganzenmüller (1), p. 98. The whole story has been told, in fascinating (if sometimes confusing) detail, by him; see pp. 71ff., 76ff., 85ff., 97ff.

^e Ganzenmüller (1), pp. 109ff.

^f (1), ch. 129.

^g Tr. Ashbee (1), p. 16.

^h This goes back at least to Gregory of Tours (d. +595), which is hard to explain unless Ganzenmüller's suspicion (p. 270 below) is justified.

ⁱ See Sect. 35, and the monograph of Garner (2).

^j The oldest known enamel work is Mycenaean, about -1200. The tradition descended through Greek to Byzantine and Arabic culture, with an important offshoot in the Celtic parts of Western Europe.

^k As Garner explains, enamels have generally been deposited in cells on the surface of a metal support. In the cloisonné technique (first used in Egypt c. -1800 for holding precious and semi-precious stones in place) the cells are made of thin wire soldered to the base. In *champlevé* the cells are carved out of the solid metal, and in *repoussé* they are fabricated by hammering the metal sheet.

^l Ch. 7, p. 23a, tr. Garner (2), p. 31. Cf. David (3), pp. 143-4.

^m Occasionally the technique was used in later times for quasi-scientific purposes, as in the case of the Rosthorn terrestrial globe, described in Vol. 4, pt. 3, pp. 587ff.

the form of rose-pink enamel^a carried eastwards to find an even more brilliant development in the famous 'famille rose' style (*yang tshai*¹) of painted polychrome porcelains.^b Between +1715 and +1730 the Jesuit Joseph de Mailla (Fêng Ping-Chêng,² +1669 to +1748),^c and other missionaries, sought experts from Europe to help the nascent Chinese ceramic enamelling industry, and one technician of apparently mediocre merit, J. B. Gravereau (+1690 to after +1757), a Jesuit lay brother, worked there from +1719 to +1722.^d Difficulties still remained, but by the middle of the century Chinese painted enamel work was being made that could hold its own with any contemporary European enamelling, however distinguished.^e

In all this there is a good deal more than meets the eye, for Ganzenmüller, in two suggestive books,^f has drawn attention to the fact that there is a strangely close connection between the gold-ruby glass and the 'philosophers' stone' of medieval Europe. He shows how often this was referred to as dark red in colour, 'glowing like the carbuncle or the ruby', and he suggests that the discovery of the colouring properties of colloidal gold had a very long hidden history, perhaps even capable of explaining the 'coral of gold' so prominent (and so perplexing) in the writings of the Hellenistic Corpus.^g There is no proof that the Arabic and early Latin alchemists made gold-ruby glass, but only a strong suspicion because of the artificial colour so often ascribed to the stone—and here there would be a significant connection too with the systematic imitation of gems by pieces of treated and dyed quartz or selenite, or by artificial glasses, so common equally in the Graeco-Egyptian papyri.^h As we saw long ago, some of these reached Han China as articles of trade and were duly recognised by the Chinese as false.ⁱ All this seems rather foreign to the pattern of Chinese alchemy and its development, but we still have so much to learn that it may yet give some clues for the

^a The oldest known example of this is German and dates from +1687, significantly close to the activities of the Cassius family.

^b Special studies of these have been made by Garner (3) and Williamson (1). The 'famille rose' is considered to have been inspired by the painted enamel work of early +17-century Europe, in which thin copper sheet was covered on both sides by a continuous layer of opaque enamel, designs then being painted on the white ground of one side with coloured enamels. The start of this had been in early +14th-century Siena, when the technique of *basse taille*, keying the enamel to the metal base by carving or engraving it before fusion, had been invented. By +1680 enamel painting on glazed pottery had also started in Europe, and the work produced at Limoges was, it is thought, influential in China.

^c See Pfister (1), no. 269.

^d Jourdain & Soame Jenyns (1), p. 67; G. Loehr (1). For the little that is known of Gravereau (or Graverot) see Pfister (1), no. 307.

^e Garner (3).

^f (1), pp. 87 ff., 101 ff., (2), pp. 175 ff., 177, 208 ff.

^g This *chrysokorallos* (χρυσόκοράλλος) was indeed described as a further stage beyond gold, following successively upon the *xanthōsis* to 'gold' and the *leucōsis* to 'silver' (cf. Pseudo-Democritus, in *Corp. Alchem. Gr.* II, i, 4). It was therefore closely related to the final *iōsis* or 'purpling', if that is what we should understand by the word.

^h Especially the Stockholm Papyrus, cf. Caley (2). See also *Corp. Alchem. Gr.* v, vi, vii, viii, ix; and Berthelot (1), pp. 123, 125, 218 ff., 221 ff., 235.

ⁱ Cf. Vol. I, p. 200. Regarding the Graeco-Syrian 'night-shining jewel' of the Chinese texts there discussed, for which chlorophane (a fluorspar) was suggested, reference should have been made to the curious memorandum of Berthelot (2), pp. 271 ff., dealing with *Corp. Alchem. Gr.* v, vii, 6-9, on the use of fish and reptile bile salts (taurocholate and glycocholate) to give a temporary phosphorescence to false gems.

¹ 洋彩

² 馮秉正

understanding of ancient and medieval Chinese texts at present hard to interpret. Of one thing at least we can feel fairly sure, namely that 'purple of Cassius' was not concerned in the 'purple gold' and 'purple sheen gold' of ancient China,^a belonging rather to the group of techniques which passed from West to East during the Jesuit period.

But if the Chinese did not find out how to 'precipitate the Sun with Jupiter', they successfully turned Jupiter into the Sun, i.e. they transmuted tin into what seemed like flakes of the finest gold. This was the process, described by Ko Hung (p. 69) but probably a good deal older than +300, for making stannic sulphide (SnS_2). The crystalline salt, 'mosaic gold',^b is easily obtained as a residue of lustrous and glittering golden-yellow hexagonal scales by heating a mixture of tin filings, sulphur and sal ammoniac; a complex reaction follows, including the intermediate formation of one of the ammonium chlorostannates. This was perhaps the crowning achievement of ancient Chinese empirical chemistry, paralleling the Hellenistic discovery of the calcium polysulphides. As we have already seen (pp. 62, 201), mosaic gold was widely used in gold paints before the secret of flaking low-zinc brass particles was mastered, and it probably played a large part in the preparation of the various forms of alchemical 'potable gold' from the time of Ko Hung onwards (pt. 3).

In Europe the discovery came much later, in the +14th century at the soonest. Whether or not stannic sulphide can be detected in one of the Geberian books (c. +1300) depends on the interpretation of a cryptic sentence which states that *aes* with sulphur will take on the appearance of the sun.^c That this refers to tin and stannic sulphide is perhaps made more likely because a singularly good and clear description of the process occurs soon afterwards, in an anonymous Neapolitan manuscript on painting and pigments known as the *De Arte Illuminandi* and dating from the mid +14th century.^d During the +15th, descriptions become numerous (though not all

^a It is of course always desirable to maintain a certain reserve, for the expression *tsu fên*,¹ 'purple powder', is not uncommon in Chinese alchemical texts. It occurs, for example, in *PPT/NP*, ch. 16, p. 19a, where Ware (5), p. 274, identifies it as litharge (PbO), though the colour of this is red, yellow or orange. It has sometimes also been taken as a cover-name for lead itself. *PTKM*, on the other hand, gives *tsu fên shuang*² as a synonym of cinnabar (HgS , vermilion, RP47). Conversely, Berthelot (1), p. 93, suggested that purple of Cassius might be the explanation of some of the *iodis* processes so prominent in the Hellenistic proto-chemical writings. Unless Ganzenmüller is right in thinking that the ancient and medieval Western experimentalists found some other way of obtaining gold chloride, one would be inclined to believe that the discovery of *aqua regia* (HNO_3 and HCl) about +1300 was the limiting factor and the *sine qua non* for any form of colloidal gold. Such strong mineral acids were certainly never known to the Hellenistic proto-chemists; nor to the ancient Chinese alchemists either, though (as we shall later see in pt. 4) they probably did make use of weak solutions of nitric acid. But that would not have sufficed here.

^b The term is sometimes misapplied to common brass, especially if purely copper and zinc, without the various minor constituent metals, and destined for the gilding of cast articles; as e.g. in Hiscox (1), p. 68; Hiorns (2), p. 153.

^c *Summa Perfectionis*, ch. 28, Darmstädter tr., p. 36, comm., taking *aes* for tin and assuming a golden product, p. 142. Multhauf (5), p. 159, accepts this; we have lingering hesitations.

^d See Partington (10), p. 521, and especially (12). The text has been published by Salazaro (1) and de la Marche (1), where the passage is on p. 258. French tr. in Dimier (1), p. 46. The chapter heading is *De Purpureo Colore... qui vocatur aurum musivum*.

¹ 紫粉

² 紫粉霜

as good), e.g. in the MSS of Jean le Begue (+1431),^a Cennino Cennini (+1437)^b and others.^c In the +16th it was greatly used. Describing a missal in the library of Henry VIII, the poet John Skelton wrote:

‘With balassis and carbuncles the border did shine
And *aurum mosaicum* every other line.’

It seems that before stannic sulphide became known, milled brass powder was used for gold paint, and tin for silver, and certainly milled gold and silver metal had an important place in the illumination of manuscripts,^d but one cannot help wondering whether the appearance of a new cheap substitute could have had any connection with the development of European heraldry,^e in which among the seven ‘tinctures’, as they were called,^f or and argent figured so largely.^g It is true that in certain countries, especially Germany, mosaic gold never displaced powdered brass or tombac,^h and by the time that Woulfe (1) made the first scientific study of it in +1771 it was being for the most part laid aside.ⁱ Partington (12) suggested that the discovery arose from the making of vermilion, a process which had been known to the Hellenistic proto-chemists,^j when someone tried to replace expensive mercury by tin, and sulphur by sal ammoniac. His impression that the cinnabar process had reached them ‘perhaps from Chinese sources’ we shall be able to evaluate better after considering the comparative development of early chemistry in the civilisations of East and West, but it prompts the further question whether it is not more likely that the mosaic gold preparation was itself an indirect transmission from the China of Ko Hung. The fact that it first appears in Geberian Europe leads one to suspect an inheritance from Arabic alchemy, and any mention of mosaic gold in the Arabic literature would thus be of much interest. Lastly, ‘mosaic silver’ is a name given to a mixed amalgam of tin and bismuth used for making silver paint;^k this could hardly have been prepared before the +16th century and was in fact first described by Kunckel (1) in +1679.^l

One further chemical gold may be mentioned—the ‘golden sulphuret of antimony’ or antimony pentasulphide (Sb_2S_5).^m This had quite a career in the Renaissance.ⁿ By about +1600 ‘Basil Valentine’ was preparing it by adding vinegar to a decoction of

^a *Experimenta de Coloribus*, etc., tr. Merrifield (1), vol. 1, p. 54.

^b *Libro dell'Arte*, chs. 62, 159, tr. Merrifield (2), p. 159; Herringham (1), pp. 47, 138; Thompson (2), pp. 36, 101. Cennini called it ‘porporina’. There is something very queer about this association of gold with purple in all civilisations.

^c Cf. Merrifield (1), vol. 1, p. xcix, vol. 2, pp. 458ff., 470, on a Bolognese MS.

^d See Theophilus’ book on diverse arts (c. +1145), especially the notes of Hawthorne & Smith (1), pp. 14ff. Also Thompson (1).

^e More properly called armory.

^f A strikingly alchemical term.

^g See Woodward & Burnett (1), vol. 1, pp. 60ff. Contrary to a common idea, heraldry developed rather late and quite suddenly in Europe, towards the end of the +12th century.

^h See p. 196 above.

ⁱ But directions for making it are still given in workshop and laboratory reference books; cf. Hiscox (1), p. 140.

^j *Corp. Alchem. Gr.* 1, xvii, v, xxiii.

^k See Hiscox (1), pp. 140, 388. Like mosaic gold, it is taken up with bone-ash, egg-albumen and varnish or gum.

^l Along with mosaic gold. Partington (7), vol. 2, pp. 375–6.

^m Partington (10), p. 638.

ⁿ Multhauf (5), p. 231.

stibnite in alkaline lye,^a and for Glauber in his *Pharmacopoeia Spagyrica* of +1656 it was a wonderful medicine, the *panacea antimonialis*.^b Lemery gave an account of it in his *Cours de Chymie* of +1675^c and later C. J. Geoffroy, Baumé and Fourcroy all studied it. If we have been right in our suspicion (pp. 190, 252, 267 above) that the medieval Chinese alchemists did know and use compounds of antimony, and stibnite was particularly available to them, the pentasulphide is a substance which one ought to be on the look out for in their texts.

(8) THANG LISTS OF 'GOLDS' AND 'SILVERS', ARTIFICIAL AND GENUINE

Let us lastly turn to the lists of true and artificial golds and silvers which have come down to us from the early Middle Ages in China. The oldest one (Table 103) need not long delay us here, for it makes no distinction between the real and the false; it is an enumeration of various categories of gold stock in the supply departments of the imperial court, preserved in the *Thang Liu Tien*¹ (Administrative Regulations of the Six Ministries of the Thang Dynasty), a work finished in +739. For most of the fourteen sorts the interpretation of the headings is fairly easy, but some remain mysterious and need question-marks in the last column.^d

Much more important for our present purpose are the lists for both gold and silver which were recorded in the *Pao Tsang Lun*² (Discourse on the Contents of the Precious Treasury of the Earth), that notable book on mineralogy, metallurgy and chemistry which is to be placed in the close neighbourhood of +918, the work of some writer of the Southern Han dynasty.^e His exact name is unknown but he seems to have used the pseudonym Chhing Hsia Tzu,³ which may mean that he felt he was continuing the work, or possibly expanding the then existing documents, of the Chin alchemist Su Yuan-Ming⁴ (+3rd and +4th centuries).^f However this may be, he listed under the heading of 'gold powder' (*chin hsiao*⁵) 20 kinds of gold, of which fifteen were artificial and only five genuine (Table 104). We take this enumeration in its most laconic form from the citation in the *Chêng Lei Pên Tshao* (+1249 edition),^g which is presumably how Thang Shen-Wei quoted it towards the end of the +11th century, but a rather fuller excerpt is given by Li Shih-Chen in the *Pên Tshao Kang Mu*^h towards the end of the +16th. The explanations in the last column will for the most part be clearly understandable from what has already been said in this sub-section, and further

^a Partington (7), vol. 2, p. 198.

^b *Op. cit.* p. 357.

^c Partington (7), vol. 3, p. 37.

^d The list is given by Chang Hung-Chao (1), p. 360. He thinks that nearly all the types and qualities were debased (*hao*⁶) with copper, etc.

^e Cf. Tsêng Yuan-Jung (1).

^f Hence the book has sometimes been dated as early as this, e.g. by Yang Lieh-Yü (1), but that is not acceptable.

^g Ch. 4, (p. 109.2).

^h Ch. 8, (pp. 3, 4). This list was given long ago by de Mély (6), p. 329, but he could not at that time understand the real purport of it.

¹ 唐六典

² 寶藏論

³ 青霞子

⁴ 蘇元明

⁵ 金屑

⁶ 耗

Table 103. *List of sorts of gold in 'Thang Liu Tien'*

		Interpretation	
1 <i>hsiao chin</i>	銷金	smelted gold	presumably refined
2 <i>pho chin</i>	拍金	beaten-out gold	gold leaf (p. 247)
3 <i>tu chin</i>	鍍金	gilding gold	gold amalgamated with mercury? or a gold-lead alloy of the more primitive type (p. 248)?
4 <i>chih chin</i>	織金	gold thread	presumably wire-drawn, or thin strips cut from leaf
5 <i>ya chin</i>	研金	'calendared', rolled or glossed gold	thin plate for coating?
6 <i>phai chin</i>	披金	unrolled gold for throw- ing on or wrapping	-do-
7 <i>ni chin</i>	泥金	'mud gold'	gold amalgam (p. 244), or alluvial gold, or paint for chrysography
8 <i>lou chin</i>	鑲金	gold for inlaying	presumably thick gold wire
9 <i>nien chin</i>	捻金	'twisted gold'	perhaps thick cord with gold wire wound in (cf. no. 4)
10 <i>chhuang chin</i>	餞金	'made' or 'created' gold	artificial or alchemical gold? (cf. the following Tables)
11 <i>chhuan chin</i>	圈金	gold rings	
12 <i>thieh chin</i>	貼金	gold for 'sticking' or 'attaching to'	gilding gold of some kind (cf. no. 3) i.e. with lead or mercury, or perhaps gold solder
13 <i>khan chin</i>	嵌金	gold for inlaying	perhaps gold strip (cf. no. 8)
14 <i>kuo chin</i>	囊金	'enveloping gold'	possibly gold plate

comment is needed only for a few, but first we had better look at variations of the technical names in parallel texts as we see how far the list can be traced back historically. For the moment the main point to bear in mind is that the writer of the *Pao Tsang Lun* is quite specific in saying that the first fifteen sorts of gold in Table 104 are false or artificial (*chieh shih chia*¹) while the final five are real or genuine (*chen chin*²).

The list in the *Pên Tshao Kang Mu* divides the false fifteen into two groups, the first eleven being designated 'all prepared from chemicals' (*ping yao chih chheng chē*³), and then four more of which it is said 'all prepared from chemicals by projection' (*ping yao tien chheng chē*⁴). The first group omits nos. 5, 10 and 11 of the *Cheng Lei Pên Tshao* list, replacing them (though the order of enumeration is not the same) with *shui yin chin*,⁵ quicksilver 'gold', *shih lü chin*,⁶ copper, or malachite (copper carbonate), or *zingār* (copper acetate)^a 'gold', and *shih tan chin*,⁷ blue vitriol (copper sulphate) 'gold'. Since we have said so much of copper and mercury as reagents of aurification this needs little further remark here.^b The second group comprises nos. 6, 7, 8 and 9 of the *Cheng Lei* list (though not in the same order). While it is easy to see how any of the brassy alloys could have been brought under the head of projection, this is not so obvious for the two forms of iron. The text goes on to say that all these fifteen are artificial, and 'if

^a Laufer (1), p. 510.^b No. 12 is also shortened to *mu sha chin*,⁸ mother sand 'gold'.¹ 皆是假² 真金³ 並藥制或者⁴ 并藥點或者⁵ 水銀金⁶ 石錄金⁷ 石礬金⁸ 母砂金

Table 104. *List of sorts of gold in 'Pao Tsang Lun'*

			Interpretation
1	<i>hsiung huang chin</i>	雄黃金	realgar 'gold'
2	<i>tzhu huang chin</i>	雌黃金	orpiment 'gold'
3	<i>tshêng chhng chin</i>	曾青金	malachite 'gold'
4	<i>liu huang chin</i>	硫黃金	sulphur 'gold'
5	<i>thu chung chin</i>	土中金	'in-the-earth gold'
6	<i>shêng thieh chin</i>	生鐵金	cast iron 'gold'
7	<i>shu thieh chin</i>	熟鐵金	wrought iron 'gold'
8	<i>shêng thung chin</i>	生銅金	crude copper 'gold'
9	<i>thou-shih chin</i>	礪石金	brass 'gold'
10	<i>sha tsu chin</i>	砂子金	sand 'gold'
11	<i>thu lu sha tsu chin</i>	土碌砂子金	rough gravel 'gold'
12	<i>chin mu sha tsu chin</i>	金母砂子金	'gold mother' sand 'gold'
13	<i>pai hsi chin</i>	白錫金	(white) tin 'gold'
14	<i>hei chhien chin</i>	黑鉛金	(black) lead 'gold'
15	<i>chu sha chin</i>	朱砂金	cinnabar 'gold'
16	<i>huan tan chin</i>	還丹金	cyclically-transformed elixir gold
17	<i>shui chung chin</i>	水中金	'in-the-water' gold
18	<i>kua tsu chin</i>	瓜子金	small nugget gold
19	<i>chhing fu chin</i>	青鉄金	caerulean bran flake gold
20	<i>tshao sha chin</i>	草砂金	'under-the-plants' sand gold
			see text
			alluvial gold particles
			also partly alluvial
			another alluvial form
			gold mined from quartz veins etc.

^a See Hiorns (1), pp. 246 ff., 252. Cf. p. 252 above.

one examines their nature they are all obstructive and poisonous'. Then come the five genuine sorts (though in fact placed first, with their origins and ores); three (nos. 16, 18, 19) being the same as those in the *Chêng Lei* list, but *shan chin*,¹ mountain gold, and *ma thi chin*,² 'horse-hoof' gold,³ being substituted for the others.^b It is rather hard to believe that Li Shih-Chen had a better and more extensive text at his disposal than Thang Shen-Wei five hundred years before him, all the more so because Li does not include the *Pao Tsang Lun* among the books to which he had personal access and used in his work, but perhaps he was quoting from some other part of it which had been handed down correctly by commentators elsewhere in the *pên tshao* literature. His version also adds the names of five kinds of gold imported from abroad.^c

Still more interesting is the fact that the *Pao Tsang Lun* list is not the oldest we still have. Two very similar ones are contained in a book in the Taoist Patrology entitled *Chhien Hung Chia Kêng Chih Pao Chi Chhêng*³ (Perfectured Precious Compendium of Lead, Mercury and Gold),^d written by Chao Nai-An⁴ in +808, and valued also because among those which contain illustrations of alchemical apparatus.^e One of these lists is essentially identical in terminology and order with that in the *Pao Tsang Lun* (*Chêng Lei* version), with very minor modifications.^f The other is also very close to it, including all three of the 'sand and gravel' entries, but taking down the two 'iron' entries to the bottom of the false fifteen, just as happens in the *Kang Mu* version.^g Neither of them divide the fifteen into two groups as that version does, and both of them make the usual sharp distinction between the five genuine sorts and the others. But the title of this second list reveals that Chao Nai-An himself was quoting. His 'Statement of the Twenty Sorts of Gold' is followed by the words: 'The *Pên Tshao*'s Discourse on Metals and Minerals says...' If then this *Pên Tshao Chin Shih Lun*⁵ was not a separate lost work (and we have been unable to trace any such title in the bibliographies), he must have been referring to some one or other of the pharmaceutical natural histories before his time. Unfortunately, none of these has been conserved to this day in full, but it is possible to check in the *Hsin Hsiu Pên Tshao*⁶ (Newly Reorganised Pharmacopoeia), compiled under the editorship of Su Ching⁷ in +659, for the expected place (ch. 4) is among those portions which the work of a

^a On this cf. pp. 257ff. above.

^b This part of the text ends by saying that all five are 'native gold' (*shêng chin*⁸), poisonous when crude but all right pharmaceutically after ten or more refinings. Cf. p. 62 above.

^c Namely *Po-Ssu tsu mo chin*,⁹ purple sheen gold from Persia (on which cf. p. 261 above), *Tung pien chhêng chin*,¹⁰ caerulean gold from the eastern frontiers, presumably Korea, *Lin-I chhih chin*,¹¹ red gold from Vietnam, *Hsi Jung chin*,¹² gold gathered by the western barbarians, possibly Tibetan or Siberian, and *Chan-Chhêng chin*,¹³ Cambodian gold.

^d TT912, cf. pt. 3. The date and authorship are not quite certain, but our conclusions here are independent of this doubt.

^e Cf. pt. 4 below for further remarks on these.

^f No. 5 has *shui* instead of *thu* as a scribal error, in no. 9 *thou*¹⁴ is written more correctly, and no. 10 is omitted altogether, so that there are only nineteen entries in all. This list is found in ch. 4, p. 2b.

^g This list appears in ch. 1, p. 18a, b.

¹ 山金

² 馬蹄金

³ 鉛汞甲庚至寶集成

⁴ 趙耐菴

⁵ 本草金石論

⁶ 新修本草

⁷ 蘇敬

⁸ 生金

⁹ 波斯紫磨金

¹⁰ 東邊青金

¹¹ 林邑赤金

¹² 西戎金

¹³ 占城金

¹⁴ 鎗

Japanese copyist has handed down to us. But the list is not there. It could also have come, however, from the important work of Chhen Tshang-Chhi¹ in +725, the *Pên Tshao Shih I*² (Omissions from Previous Pharmacopoeias). In any case it is clear that the lists of alchemical and real golds originated some time during the +7th or +8th century, very likely antedating the *Thang Liu Tien* list and quite possibly going back to the time of Sun Ssu-Mo in the Sui. This is as far as we can get, but clearly the age of this conscious and frank recognition of aurification is a venerable one.

Returning now to the *Pao Tsang Lun* list, we may let it be with only a few further comments. The orpiment gold (no. 2), suggesting the action of both arsenic and sulphur in aurification and aurifaction, is noteworthy in connection with the orpiment gold mentioned by Pliny (cf. p. 255 above). The 'in-the-earth' gold (no. 5) one would expect to be genuine rather than artificial, but perhaps we should understand an earthen crucible or reaction-vessel, in which case stannic sulphide might be referred to. The two iron entries (nos. 6, 7) are interesting in connection with the activities of the successful Sung aurifactor Wang Chieh (cf. pt. 3 below), but it is hard to be sure of the right interpretation for them. The 'sand and gravel' entries (nos. 10, 11, 12) are also quite obscure, since one would expect real alluvial gold, but possibly golden ores of other metals could explain them.^a The strangest feature of the list is to find 'cyclically-transformed elixir gold' (*huan tan chin*³) heading the group of sorts of genuine gold (no. 16), for if one thing would seem fairly clear from all this it would be that the man who first drew up the list and those who subsequently copied it did not believe in aurifaction. There are several possible explanations. One is that among certain groups of Chinese alchemists at least the expression 'cyclically-transformed', so often used in other connections and by others to mean the decomposition of cinnabar and the union of mercury and sulphur many times repeated, here signified, almost in cover-name style, the repeated purification of gold by cupellation. Alternatively, following the Chikashige theory (cf. p. 67), one could suppose that in some circumstances and using auriferous starting materials, the Chinese alchemists of Chin, Liu Chhao and Thang times did actually produce some real gold.^b The longer version of the text given by Li Shih-Chen^c says of *huan tan chin* that it comes from cinnabar mines and still has something of cinnabar in its substance; it can be made into a medicine and taken internally—a rare and precious thing in the world. This suggests that at some periods gold was extracted from auriferous ore found in association with deposits of cinnabar, and indeed veins of such ores are particularly liable to occur where there are sulphide masses, as in Szechuan and Kweichow,^d though (as Li hints) they never rivalled the yield of gold from alluvial placers. A third hypothesis would be,

^a There is quite a lot of chalcopryite in China; cf. the survey of Ong Wên-Hao (1), and Torgashev (1), pp. 195ff. Or conceivably *sha* could stand for *tan sha*, cinnabar, and they would be further items in mercuric aurification.

^b I.e., from a number of minerals and chemical substances none of which were believed to contain any.

^c *PTKM*, ch. 8, (p. 3).

^d Di Villa (1), p. 84; Bain (1), p. 159. Details in Ong Wên-Hao (1). Cf. Torgashev (1), pp. 121 ff. Western Yunnan is especially noted for the association of gold and mercury; Tegengren (3), p. 4; Moore-Bennett (1); Rocher (1), vol. 2, p. 247.

¹ 陳藏器

² 本草拾遺

³ 還丹金

therefore, that *huan tan chin* simply meant gold derived from mining lodes adjacent to cinnabar. Finally, in view of the intimate association between the concept of cyclical transformation and metallic mercury, it is open to us to interpret this real, though 'elixir', gold, as gold produced from auriferous sands or earth by the amalgamation process, certainly ancient both in East and West.^a

We pass to the silver lists. The *Pao Tsang Lun* series of +918 (as given in the *Chêng Lei Pên Tshao* of +1249) is shown in Table 105. The Wu Tai writer is just as definite as before in saying that the first twelve sorts of silver are false or artificial, while the last five are genuine, making seventeen in all as against the former twenty. Apparently Chao Nai-An a century earlier had been much less interested in silver than in gold, at any rate there seems no trace of a list of silvers in the *Chhien Hung Chia Kêng Chih Pao Chi Chhêng* as we have it now. But the author of the *Pao Tsang Lun* is backed up by two other proto-metallurgical chemists writing in the same century. First, an almost exactly identical list of names was contained in the *Jih Hua Chu Chia Pên Tshao*¹ (The Sun-Rays Master's Pharmaceutical Natural History, collected from Many Authorities),^b finished about +972, and we possess it now partly because it was fully quoted by Kao Ssu-Sun² in his *Wei Lüeh*³ of c. +1190.^c Not only the technical terminology but also the order is the same, the sole difference being the omission of no. 5, the Tanyang silver, evidently a cupro-nickel—possibly this was felt among the Taoists of the time and place to be 'restricted information'. There were thus here eleven false kinds and five genuine ones. Another list of silvers, of a rather different kind, is to be found in the *Tan Fang Chien Yuan*⁴ (Mirror of Alchemical Processes and Reagents),^d written by Tuku Thao⁵ about +950. Here we find 'white silver' (*pai yin*⁶),^e undoubtedly an amalgam of one or other of the white metals, and so corresponding to no. 1, as also must *shui yin yin*,⁷ quicksilver-silver. Cinnabar silver (*chu sha yin*⁸) clearly suggests no. 16, winning by amalgamation; and lead silver (*chhien yin*⁹) equally no. 17, the cupellation of argentiferous lead. 'Tin silver' (*hsi yin*¹⁰) recalls no. 2 (tin-lead-zinc alloys of silver), and 'iron silver' (*thieh yin*¹¹) no. 6; it is interesting that Tuku says of them both that 'they have no *chhi* of fundamental change' (*pien hua chih chhi*¹²), which might indicate surface films or layers rather than uniform-substrate alloys. Lastly, 'red silver' (*hung yin*¹³), which can 'hook' or fix gold, is not easy to explain, though we suspect a cupro-nickel; and as for 'child-and-mother silver' (*tzu mu yin*¹⁴), described as an amalgam which will retain its mercury however strongly heated, we must leave it unexplained. Thus Tuku Thao's list is in a somewhat different

^a Cf. Mellor (1), p. 385; Gowland (9), pp. 202 ff. Rocher, *loc. cit.*, gives an account of the winning of gold by amalgamation at Yungpei in Yunnan.

^b The Sun-Rays Master's real name was Ta Ming¹⁵ or Thien Ta-Ming.¹⁶

^c It will be remembered that an important passage of this was discussed earlier in this sub-section (p. 205), and that the consideration of the list of Jih Hua Tzu contained in it was postponed until now. The list occurs in ch. 5, p. 16, and has been reproduced by Chang Hung-Chao (1), p. 326.

^d There is a more or less abridged translation of ch. 1 by Fêng Chia-Lo & Collier (1).

^e 'Silver powder' (*yin fên*¹⁷) is prepared from it, after driving off the mercury.

¹ 日華諸家本草

² 高似孫

³ 韓畧

⁴ 丹方鑑源

⁵ 獨孤潛

⁶ 白銀

⁷ 水銀銀

⁸ 朱砂銀

⁹ 鉛銀

¹⁰ 錫銀

¹¹ 鐵銀

¹² 變化之氣

¹³ 紅銀

¹⁴ 子母銀

¹⁵ 大明

¹⁶ 田大明

¹⁷ 銀粉

Table 105. List of sorts of silver in the 'Pao Tsang Lun'

		Interpretation	
1	(chen) ^a shui yin yin 眞水銀銀	mercury 'silver'	any of the silvery amalgams (p. 242), or copper surface-tinged with mercury (p. 19)
2	pai hsi yin 白錫銀	(white) tin 'silver'	some debasement of silver with tin, zinc or lead (p. 226) ^b
3	tsêng chhing yin 曾青銀	malachite 'silver'	a copper-silver debasement alloy, as in many modern coinages (cf. p. 239) ^c
4	thu lu yin 土碌銀	'gravel silver'	difficult to interpret, but following Table 104, no 11, might be some silvery-looking ore not containing silver
5	Tan-yang yin 丹陽銀	Tanyang 'silver'	clearly a cupro-nickel (cf. pp. 225 ff.)
6	shêng thieh yin 生鐵銀	cast iron 'silver'	cast iron silvered or silver-plated by a variety of methods (cf. p. 247)
7	shêng thung yin 生銅銀	crude copper 'silver'	presumably cupro-nickel; or else copper or brass tinned, or silvered or silver-plated; alternatively surface-tinged with mercury or arsenic; or arsenical copper (pp. 223, 241)
8	liu huang yin 硫黃銀	sulphur 'silver'	copper or brass surface-tinged with sulphides
9	phî shuang yin 砒霜銀	arsenical 'silver'	cupro-nickel (paktong) if made with nickel arsenide (cf. p. 232); or arsenical copper (p. 223)
10	hsiung huang yin 雄黃銀	realgar 'silver'	{ copper-arsenic combinations (with or without nickel), or else silvery or yellow surface-films of arsenic or sulphur on copper or alloys of base metals
11	tzhu huang yin 雌黃銀	orpiment 'silver'	
12	thou-shih yin 鎗石銀	brass 'silver'	
13	chih yao yin 至藥銀	silver from the best chemical (i.e. mineral)	silver smelted from argentite (Ag ₂ S, silver glance), as at Laurion (?)
14	shan tsê yin 山澤銀	silver from the mountain wildernesses	native silver found at shallow depths.
15	tshao sha yin 草砂銀	silver from 'under-the-plants' sand	native silver mined from dendritic or wire-like veins
16	tan sha yin ^d 丹砂銀	cinnabar silver	i.e. mercury silver, i.e. silver isolated by amalgamation, as in the Mexican patio process ^e
17	hei chhien yin 黑鉛銀	(black) lead silver	clearly silver after cupellation with lead, or silver obtained from argentiferous galena (cf. p. 36)

^a This word seems to have slipped in accidentally.^b Cf. Hiorns (2), pp. 320 ff., 395 ff.^c Cf. Hiorns (2), pp. 399 ff.^d The *Pao Tsang Lun* list has in both versions *mu sha yin*, 'mother sand silver', but we write it thus here in accordance with the form in the *Yih Hua Tzu* list (see p. 278).^e Cf. Mellor (1), p. 382; Gowland (9), p. 299.

tradition from those of Jih Hua Tzu and the writer of the *Pao Tsang Lun*, yet sufficiently close to them to help us to round out our ideas of the knowledge of these +10th-century metallurgical chemists.

When we come to look at the list as quoted in the *Pên Tshao Kang Mu*^a we find a situation quite parallel to that for the different sorts of gold. There are, however, thirteen kinds of artificial silver and only four genuine kinds (not twelve and five, as in the *Chêng Lei* version), and of the former, nine entries form a group 'prepared by the use of chemicals', with four more 'prepared from chemicals by projective transmutation' (*i yao tien hua ché*¹). Although Li Shih-Chen is supposedly quoting from the same *Pao Tsang Lun*, the list omits the 'gravel silver' (*thu lu yin*,² no. 4) unless this was always a mistake for *shih lü yin*,³ copper (carbonate or acetate) 'silver', which now replaces it; as also the arsenical (nickel) 'silver' (no. 9) and the brass 'silver' (no. 12). Instead of these it adds a *tan fan yin*⁴ or copper sulphate 'silver' (similar to what happened in the gold list), and a *ling tshao yin*,⁵ the meaning of which is extremely obscure.^b Furthermore, inexplicably, it takes *tshao sha yin*⁶ (no. 15) out of the genuine five and moves it up to second place among the false thirteen.

The *Kang Mu* version of the *Pao Tsang Lun* list is also rather different as regards the four genuine kinds of silver, its account of which (as in the case of gold) precedes the enumeration of the false kinds.^c Its first item, *thien shêng ya*⁷ or 'natural sprouts', must correspond to nos. 14 and 15 in Table 105, the synonyms *lung ya*⁸ (dragon sprouts) and *lung hsiu*⁹ (dragon beard) referring well enough to the dendritic or wire-like veins in which native mine silver is so often found. The *Chêng Lei* version's ending corroborates, saying: 'within the crevices in the silver mines the substance often appears like pieces of thread. Hence the local people call it "elderly gentleman's beard" (*lao ong hsiu*¹⁰). This is real native silver.' Then the *Kang Mu* version's second category is *shêng yin*,¹¹ native silver, of which, among other things, it says *chih yao kên pên yeh*,¹² a clear enough reference to the *chih yao yin*¹³ of the Table (no. 13); all of which seems simply to amount to saying that the silver obtained from the sulphide is really the same as that found native. We have suggested in Table 105 that *chih yao yin* was silver from natural silver sulphide, but one ought to leave room for the possibility at least that it included silver obtained from the sulphurisation parting process whereby the

^a Ch. 8, (pp. 5, 6).

^b No such 'numinous plant' is known in the Chinese botanical literature. There is, however, the *ling fêng*¹⁴ tree, *Liquidambar formosana*, which produces a resinous gum (Fig. 1339b, cf. p. 142 above and Vol. 1, pp. 202ff.), and this might have been used for applying silver or a silvery powder in the form of a paint. There is also *ling thung*,¹⁵ the liquorice-like plant *Glycyrrhiza glabra*, better known as *kan tshao*,¹⁶ so much used in medicine, but like *ling chih*,¹⁷ the 'magic mushrooms', it can presumably be ruled out of court here. On all three see Khung *et al.* (1), pp. 1578ff.

^c The *Kang Mu* version adds note of four sorts of silver imported from abroad: *Hsin-Lo yin*¹⁸ from Silla in Korea, *Po-Ssu yin*¹⁹ from Persia, *Lin-I yin*²⁰ from Annam, and *Yün-nan yin*.²¹ The last was naturally thought of as foreign in the +10th century because the local Nan Chao kingdom continued down as late as the end of the Sung in sturdy independence.

¹ 以藥點化者

⁶ 草砂銀

¹¹ 生銀

¹³ 雲通

²⁰ 林邑銀

² 土碌銀

⁷ 天生牙

¹² 至藥根本也

¹⁶ 甘草

²¹ 雲南銀

³ 石綠銀

⁸ 龍牙

¹⁷ 靈芝

⁴ 膽礬銀

⁹ 龍鬚

¹³ 至藥銀

¹⁸ 新羅銀

⁵ 靈草銀

¹⁰ 老翁鬚

¹⁴ 靈楓

¹⁹ 波斯銀

metal was separated as the sulphide from gold (cf. p. 38 above). And indeed we have a modern eye-witness account of this process at work in traditional Yunnan.^a Of the third category (*mu sha yin*,¹ agreeing with the *Chéng Lei* version rather than Jih Hua Tzu, no. 16) it says that it is found in cinnabar mines and that it has a reddish colour; this suggests the possible use of proustite as a source of silver (the mixed sulphides of silver and arsenic, $3\text{Ag}_2\text{S} + \text{As}_2\text{S}_3$) since that ore is pale red in colour. But *mu* may always have been a mistake for *tan*, and the obtaining of silver by amalgamation is by no means excluded. Finally all the lists agree on black lead silver (no. 17), which must surely refer to cupellation and the winning of silver from argentiferous galena.^b

From these paragraphs and tables, in spite of obscurities of detail, several things emerge clearly. Those who compiled, copied and modified the lists were evidently quite familiar with a number of different kinds of artificial gold and silver, as well as with the true and genuine metals produced in several different ways; they must therefore have understood both cupellation and a number of well-tried techniques of aurification and argentification. They must have had expertise with uniform-substrate alloys such as low-zinc brasses and cupro-nickel, they must have understood plating, gilding, silvering and tingeing or 'bronzing' with surface-films of microscopic thinness. By the same token they must have said goodbye to the belief in aurifaction and argentifaction, however many subsequent centuries were to pass before adepts and their patrons could no longer tread this gambit. In the time of Ko Hung (c. + 300), as we saw at length above (pp. 65 ff.), cupellation was well enough known to the Taoist alchemists, but they deliberately defined their gold in a different way from the artisans, claiming indeed that for the attainment of material immortality the artificial gold-looking stuff was positively superior to natural gold. The milieu of the *Pao Tsang Lun* four hundred years later (for we have seen how its lists go back to the beginning of the Thang) breathes evidently a very different atmosphere; it is nearer to the artisans than to the Taoist religious philosophers and alchemists, and concerned to distinguish cold-bloodedly, without thought of their quasi-magical pharmaceuticals, between sorts of gold and silver that were real (in our modern sense) and those which were not. If then the history of chemistry can be considered to have distinguishable stages, even revolutions major and minor, it would not perhaps be too much to say that a decisive step forward in scientific thinking was taken during those four centuries. That the Thang period was a great one in the history of Chinese alchemy will appear more and more as this Section continues, but one sees its greatness nowhere better than here. Long before the end of the early Middle Ages, and well before the period when China exerted so much influence upon Arabic (and hence in due course European) alchemy, the distinction between false gold and real gold, indeed between aurifiction and aurifaction, had become clear to a central group of Chinese proto-chemists. *Quod*, as one might say, *erat demonstrandum*.

^a Rocher (1), vol. 2, p. 246.

^b An excellent eye-witness account of Yunnanese cupellation methods, with scale-drawings of the furnaces, is given by Rocher (1), vol. 2, fig. VIII, pp. 240 ff.

¹ 母砂銀

(d) THE PHYSIOLOGICAL BACKGROUND; VERIFICATIONS
OF THE EFFICACY OF ELIXIRS

(1) INITIAL EXHILARATION

Of the motivations of Chinese elixir alchemy much has already been said in our subsection on terms and definitions, especially in the description (pp. 81 ff. above) of the peculiarly Chinese concept of material immortality. The association of unsullied duration with the metal gold was an essential part of the story, and the next step therefore was to gain some fairly detailed understanding of what exactly the ancient and medieval Chinese alchemists were doing when they engaged in their aurifaction. But there is a physiological as well as a metallurgical background to alchemy in China. Since the numberless elixir mixtures of the Middle Ages contained all kinds of dangerous metallic compounds derived from arsenic, mercury, lead, copper, tin, nickel, zinc and perhaps antimony, how was it possible that they could be attractive to so many aspirants, and how could people have been tempted to persevere in their use? Through the centuries case after case of elixir poisoning became notorious, yet the addiction continued.^a Surely the only explanation is that many of the mineral preparations, especially perhaps those containing arsenic, were capable of giving a transient sense of well-being, after which there came a point of no return. The insidiousness of arsenic poisoning is well known,^b and the initial tonic effects would have acted as nothing less than a kind of bait, inveigling the believer further and further beyond the danger-line of irretrievable intoxication.^c

Here the two most important appetites would be those of food and sex.^d An introductory phase of loss of hunger combined with enhanced appetite could have led to temporary loss of weight and that 'lightening of the body' (*chhing shen*¹) which is mentioned so constantly in the descriptions of elixir action. But sex was even more important. Apart from natural desires which a polygamous system could stimulate and satisfy, there was in traditional Chinese society a certain domestic pressure not only on members of the imperial house but also on all patricians and officials of any eminence, surrounded as they were by queues of secondary consorts, concubines and deputy concubines.^e Failure to satisfy the natural needs of the many women of a great household could lead to political complications, since male relatives outside were liable to take up slights (or fancied slights) put upon their sisters within. If therefore an elixir composition had the effect of heightening, though only temporarily, the sexual powers

^a See Sect. 45 in Vol. 6, and meanwhile Ho Ping-Yü & Needham (4), reprinted in Needham (64), pp. 316 ff.

^b 'Arsenicals poison surreptitiously, the victim consuming poisoned food with fair appetite until the end' (Frost, 1).

^c A typical arsenical prescription is given in *CLPT*, ch. 4, (p. 102.1, 102.2), from the (*Thai-Shang*) *Tung Shen Pa Ti Yuan (Hsüan) Pien Ching*, probably a work of the Tang period, *TT*1187.

^d As Kao Tzu says in Mencius: *shih sê hsing yeh*² (*Mêng Tzu*, VI (1), iv, 1).

^e Some idea of what this implied may be gained from the account of typical palace arrangements in Vol. 4, pt. 2, pp. 477-8.

¹ 輕身

² 食色性也

of the believer, it would seem extraordinarily successful, with every promise of greater wonders to come,^a and later phases of irreversible depression would not deter him from wading deeper and deeper into the toxic danger-zone. Thus we are perforce involved with the pharmacology and toxicology of the metals and semi-metals, especially arsenic; as also with tonic and aphrodisiac drugs in general, since elixir preparations were never strictly confined to mineral substances.

That perseverance in the taking of elixirs was counselled over and over again we know; a single good example may be taken from the *Pao Phu Tzu* book. Ko Hung says:

If flesh and blood could mount up into the heavens after swallowing the *chhi* and taking (medicinal substances) for a single day, or if feathers and wings were to sprout after a mere month's practice of the gymnastic exercises, there is no one in the world who would fail to believe in the adepts of the Tao. I fear, however, that before a spoonful of benefit can be crystallised, the expense (of effort) has rather to be measured in vats... Before anything secure can be attained, the poisonous effects inherent in the sublimates and precipitates (lit. ice and frost) have to be overcome. Yet not knowing that the fault lies in themselves, men turn against the Taoist processes, declaring that they are profitless; and soon they abandon the pills and powders, and stop practising the respiratory techniques.^b

And untoward symptoms were not to be allowed to frighten the aspirant to immortality, who should be persuaded that they were but signs of the efficacious working of the elixir. A striking passage in the *Thai-Chhing Shih Pi Chi*¹ (Records in the Rock Chamber), a text of the early +6th century but containing some material as old as the late +3rd, runs as follows:^c

After taking an elixir, if your face and body itch as though insects were crawling over them, if your hands and feet swell dropsically, if you cannot stand the smell of food and bring it up after you have eaten it, if you feel as though you were going to be sick most of the time, if you experience weakness in the four limbs, if you have to go often to the latrine, or if your head or stomach violently ache—do not be alarmed or disturbed. All these effects are merely proofs that the elixir you are taking is successfully dispelling your latent disorders.

Here we find many symptoms quite characteristic of metallic poisoning: formication, oedema and weakness of the extremities, later leading to infected boils and ulcers, nausea, vomiting, gastric and abdominal pain, with diarrhoea, and the inevitable headaches. All were to be supported with courage and faith. Alas, such fortitude was the ruin of many a Taoist adept and believer.

So much for the theory of the bait, but there is one further question needing treatment in this context. If the metallic elixirs could be objectively 'verified' by the beneficial effects which they seemed to produce in the initial stages, so also perhaps

^a In this connection one is inclined to wonder whether the administration of hallucinogens (either from phanerogams or cryptogams) was not sometimes at least part of the elixir treatment given by the Taoist adepts to their disciples or patients (cf. pp. 116 ff. above).

^b Ch. 13, p. 2a, tr. auct., adjuv. Ware (5), p. 214.

^c Ch. 2, p. 7a, tr. Ho Ping-Yü (8), Sivin (1), p. 143. TT874.

¹ 太清石壁記

could physical immortality be 'verified' by the incorruptibility of the corpse after the terminal stages. The elixirs were to generate a new physical but immortal self, embodying the whole personality, which could leave the adept's corpse like a butterfly emerging from a chrysalis, and go off to dwell among the other immortals.^a The process of 'liberation from the corpse' (*shih chieh*¹) could result therefore either in an empty coffin (if the physical frame were fully etherialised) or in the changeless perpetuation of the adept's body, light in weight like an empty cocoon, and showing no signs of decay after death. For Ko Hung this was perfectly natural. In the *Pao Phu Tzu* he wrote:^b

When gold and jade are inserted into the nine orifices,^c corpses do not decay. When salt and brine are absorbed into flesh and marrow, dried meats do not spoil. So when men ingest substances which are able to benefit their bodies and lengthen their days, why should it be strange that (some of these) should confer life perpetual?

The abolition of decay was indeed a demonstration of power, 'the corruptible had put on incorruptibility', and there is every reason to believe that it actually happened, as we shall presently see. The explanation of this subject will involve the strange and little-known fact that procedures of self-mummification go back a very long way in East Asia, and have in fact been carried out within living memory. But again they rest upon physiological factors, in this case an extremely severe nutritional régime rather than the pharmaceutic action of mineral and plant drugs. These must be considered first.

Descriptions of the phenomena of chronic and acute poisoning by arsenic, mercury and lead,^d with the effects of prolonged exposure to sulphur, antimony, selenium and other elements, are readily available and well known;^e but here we do not need them, and they may therefore be reserved for Sect. 45, where the terminal stages of elixir poisoning^f will be discussed in relation to what the Chinese knew in pre-modern times about industrial diseases. What is important for the theory of the bait is rather a study of the transient effects produced by small amounts of the toxic elements during the early stages of their action. One has to approach this in two ways, first by seeing what properties the medieval Chinese books ascribed to various mineral substances and preparations,^g and secondly by comparing this with the views which have been entertained during the period of modern science, especially the conclusions of the last half-century. We need not multiply examples.

^a The formulation of Sivin (1), p. 41, is followed here.

^b Ch. 3, p. 6a, b, tr. auct., adjuv. Ware (5), p. 62.

^c Cf. Vol. 4, pt. 3, p. 544.

^d On lead poisoning and its prevalence in Western antiquity there is a classical paper by Kobert (1).

^e See e.g. Sollmann (1) or Goodman & Gilman (1). Among older books Pereira (1) or Whitla (1) can be consulted.

^f Pending the appearance of Vol. 6, see the paper by Ho Ping-Yü & Needham (4) already mentioned.

^g It must be remembered that these were rarely given alone, but generally with material of plant or animal origin, either as a vehicle (jube-date pulp, honey, lard) or as an adjuvant drug in accordance with the Chinese manner of prescribing. Some of these organic components were considered to be aphrodisiacs or tonics in themselves, others may well have contained vitamins and other nutrients valuable for the general well-being of the person (cf. p. 292 below).

¹ 尸解

It is clear then, to begin with, that the arsenic sulphides (realgar and orpiment) were granted aphrodisiac properties,^a effectively lifting impotence (*Yang shih pu chü*,¹ *Yin wei, pu chhi*²).^b One finds this, for instance, in the *Thai-Phing Hui Min Ho Chi Chü Fang*³ (Standard Formularies of the (Government) Great Peace People's Welfare Pharmacies),^c an official receptorium enlarged from earlier versions by Chhen Shih-Wên⁴ and his colleagues in +1151. Here they were combined with cinnabar and sulphur in a composition called *Ssu Shen Tan*⁵ (elixir of the four magical ingredients).^d But it is also interesting in relation to possible tonic action that they are repeatedly said, as in the *Chêng Lei Pên Tshao*⁶ (Reorganised Pharmacopoeia), to avert hunger (*pao chung pu chi*⁷), to lighten the body (*chhing shen*⁸), and to be good for longevity (*tséng nien*⁹).^e Again, arsenolite (naturally occurring arsenic trioxide forming arsenious acid), if in very small doses given with other things, cures debility and impotence and disperses congestions (*kung chi chi chü ku léng chih ping*¹⁰),^f also lightening the body; but if too much is taken fevers (*jé ping*¹¹) and mineral poisoning (*shih fa*¹²) will result.

^a A special Chinese use of realgar was the carving of the natural mineral into cups of great beauty. One of these (Fig. 1328) was illustrated by Hanbury (1) in 1876, who remarked that 'when the inner surface of the cup is, as sometimes happens, in a somewhat disintegrated state, it is evident that a minute dose of arsenic may be administered'. One such cup brought to Paris in +1684 by the Siamese ambassador was identified analytically by W. Homberg in +1703; on him see Partington (7), vol. 3, p. 42.



Fig. 1328. Medicine-cup carved from a lump of realgar and mounted on a wooden stand (Hanbury (1), p. 221). Probably Chhing period.

^b The Yang function is spoken of here, but the Yin apparatus or the Yin weakness.

^c Ch. 5, (p. 96).

^d This is actually a far older name (though the contents of the prescription were not always identical), for we find it mentioned many times in the *Thai-Chhing Shih Pi Chi* of the +6th century or rather earlier; tr. Ho Ping-Yü (8). There it is not so much described as taken for a model according to which other compositions of mineral substances are to be made.

^e Ch. 4, (p. 101.1 and 103.2, 104.1). We quote from the *editio princeps* of +1249 but most of the text goes back to the original writer Thang Shen-Wei¹³ in +1108. Thao Hung-Ching is quoted as saying that the 'Manuals of the Immortals' never counsel taking orpiment alone, but only with cinnabar and other things.

^f CLPT, ch. 5, (p. 124.1), quoting *Hsin Hsiu Pên Tshao* (Thang) and *Pên Tshao Thu Ching* (Sung).

¹ 陽事不舉

² 陰痿不起

³ 太平惠民和局方

⁴ 陳師文

⁵ 四神丹

⁶ 證類本草

⁷ 保中不飢

⁸ 輕身

⁹ 增年

¹⁰ 攻擊積聚癰冷之病

¹¹ 熱病

¹² 石發

¹³ 唐愼微

Compound pills containing arsenic trioxide are also described in Sun Ssu-Mo's¹ *Chhien Chin I Fang*² (Supplement to the Thousand Golden Remedies),^a c. +670.

Sulphur itself is said to strengthen the male functions (*chuang Yang tao*³);^b it 'stiffens and edifies the male essence, dissolving the Yin and modifying the influence of the *pho* soul' (*thing li Yang ching, hsiao Yin hua pho*).^c It was also used to cure female frigidity.^d Mercuric sulphide and mercury were regarded as abortifacients (*thai*⁵);^e but both occur as constituents of no less than five formulae (containing other minerals, plant drugs and perfumes) recommended in the *Thai-Phing Hui Min*... *Fang*^f as curing debility (*ku leng*⁶) and male exhaustion (*nan tzu chen yuan shuai pai*⁷),^g 'assisting the Yang and restoring the primary (vitalities)'^h (*chu Yang chieh chen*⁸). An external application of mercury in ointment form was used for impotence in the Thang and Wu Tai periods before Tamba no Yasuyori⁹ recorded it in his marvellous compendium of medicine, the *I Hsin Fang*¹⁰ (*Ishinhō*),ⁱ finished in +982 but not printed till 1854. This was probably a much older custom since Tamba attributed it to Ko Hung himself.

Many other actions of mineral substances on the generative system can be found noted in the old books. A positive action on fertility (*ling jen yu tzu*¹¹), 'warming the uterus' (*nung nuan tzu kung*¹²), was attributed to blue vitriol,^j magnetite (black iron oxide),^k actinolite (calcium magnesium silicate)^l and fluorspar.^m Stalactitic calciteⁿ and quartz^o were thought to increase sexual potency (*chien i Yang shih*¹³) and to strengthen the male functions (*chuang Yang tao*³), while seminal exhaustion (*ching fa*¹⁴) was relieved by actinolite;^l fluorspar or amethyst too^m were supposed to cure weakness

^a Ch. 15, (p. 168.1).

^b *CLPT*, ch. 4, (p. 103.1), quoting *Jih Hua Tzu*¹⁵ (+972); also *TPHMF*, ch. 5, (p. 104) against spermatorrhoea.

^c *CLPT*, ch. 4, (p. 103.2), quoting a *Thai-Chhing Fu Lien Ling Sha Fa*¹⁶ (On the Method of Ingesting Transformed Cinnabar; a Thai-Chhing Scripture), a tractate apparently not in the *Tao Tsang* now. On the *pho* and *hun* 'souls' (an unsatisfactory word), cf. pp. 85 ff. above.

^d *I Hsin Fang*, ch. 28, (p. 656.1), attributing this to 'Tung Hsuan Tzu'¹⁷ (cf. Vol. 2, pp. 147-8, and Vol. 5, pt. 5).

^e *CLPT*, ch. 4, (p. 107.2), quoting the *Yao Hsing Lun*¹⁸ (Discourse on the Natures and Properties of Drugs), probably a Liang text (+6th century) now extant only in citations.

^f Ch. 5, (pp. 89, 96, 100, 107, 109).

^g One of these formulae was called *Chen Ling Tan*¹⁹ (earth-shaking numinous elixir), and the composition was attributed to the Lady Wei, that eminent matriarch of the Mao Shan school whom we have already encountered (p. 152 above). It was a Tzu Fu Yuan-Chün Nan Yo Wei Fu-jen Fang.²⁰

^h On the meaning of this expression see Vol. 5, pt. 5.

ⁱ Ch. 28, (p. 655.1).

^j *CLPT*, ch. 3, (p. 89.2), quoting the *Shen Nung Pén Tshao Ching*, unquestionably Han in date.

^k *CLPT*, ch. 4, (p. 111.2).

^l *CLPT*, ch. 4, (p. 113.2).

^m *CLPT*, ch. 3, (pp. 92.2, 93.1), quoting *SNPTC* and *YHL*; also *CCIF*, ch. 22, (p. 259.1).

ⁿ *CLPT*, ch. 3, (p. 83.1), also *CCIF*, ch. 22, (pp. 257-8). The *I Hsin Fang* has under this heading a systematic classification of failures in the erectile process, ch. 28, (p. 652.1), which it attributes to the *Chhien Chin Fang* of Sun Ssu-Mo, though we have not so far been able to locate it there.

^o *CLPT*, ch. 3, (p. 92.2), quoting *Jih Hua Tzu*.¹⁵

¹ 孫思邈

² 千金翼方

³ 壯陽道

⁴ 挺立陽精消陰化魄

⁵ 墮胎

⁶ 癆冷

⁷ 男子真元衰憊

⁸ 助陽接真

⁹ 丹波康賴

¹⁰ 醫心方

¹¹ 令人有子

¹² 能懷子宮

¹³ 建益陽事

¹⁴ 精乏

¹⁵ 日華子

¹⁶ 太清服鍊靈砂法

¹⁷ 洞玄子

¹⁸ 藥性論

¹⁹ 震靈丹

²⁰ 紫府元君南嶽魏夫人(丹)方

and debility (*pu hsü chhu ku lêng*¹). The amount of semen was thought to be increased or benefited by mica (*i tzu ching*²);^a calcite^b cured spermatorrhoea (*chu hsieh ching*³). All these effects, belief in which was evidently strong among the ancient and medieval Chinese physicians, are more difficult for us to understand than those which involved pharmacologically powerful metallic and mineral elements, except in so far as one may envisage general tonic actions of calcium, magnesium, iron, fluorine and any trace elements which had been lacking in the food. If in those days milk and milk products were as conspicuously absent from the Chinese diet as was the case in later times, a chronic insufficiency of lime could well be suspected. The real question is to what extent the methods of preparation of the various mineral substances concerned, some of which are very insoluble, could have succeeded in getting effective absorption, even with long-continued medication, but this could only be answered by a detailed study of the texts which has not yet been made. The consensus of so many physicians, by no means to be despised as clinical observers, suggests that something very useful was getting in, and most of the effects could perhaps be put down to the relief of mineral deficiencies.

This interpretation is all the more convincing if one remembers that throughout history certain deficiency states were endemic in the different parts of China.^c Bone diseases and deformities such as rickets and osteomalacia^d were characteristic of the northern wheat-growing region since earliest times,^e while swelling or wasting of the extremities, as in beri-beri,^f was equally ancient and characteristic of the southern rice-growing region.^g Obviously minerals and vitamins alone would go a long way towards restoring normal health and sexual activity.^h All the troubles, moreover, were exacerbated by parasitic diseases of every kind, and these in their turn would have been attacked therapeutically in one way or another by the elixir minerals and metals.ⁱ

These inorganic substances were rarely given alone, but made up in standard composite formulae after careful purification. Sun Ssu-Mo between +650 and +680 has much to say of these,^j giving the prescriptions for the ancient formulae called Wu

^a *CLPT*, ch. 3, (p. 80.2), quoting *SNPTC*.

^b See fn. n on p. 286.

^c See on this the relatively modern geographical pathologies of Jefferys & Maxwell (1) and Snapper (1), pp. 9 ff.

^d Cf. Miles & Fêng (1); Maxwell (1); Maxwell, Hu & Turnbull (1); Tso (1); Hedblom (1).

^e On the historical pathology see Yü Yün-Hsiu (1), pp. 157 ff. and Lu Gwei-Djen & Needham (4).

^f A good provisional account is in Wang Chi-Min & Wu Lien-Tê (1), pp. 211 ff.

^g For maps and discussions of the regions see Buck (1), p. 25, Map 3; Cressey (1), figs. 47, 48, 49; Shen Tsung-Han (1), pp. 132 ff. It is not often noticed that the borderline, which runs east-west more or less at the level of the Huai Valley, coincides roughly with the political divisions between north and south after the San Kuo period—Chhien Chao against Western Chin (+265 to +316), or Chhien Chhin against Eastern Chin (+352 to +384), or Northern Wei and its successor States against Liu Sung, Chhi and Liang (till the mid +5th century). It would be an interesting task to correlate the pharmacy and alchemy of different periods with the living conditions of north and south.

^h On the early understanding of deficiency diseases in China see Lu Gwei-Djen & Needham (1).

ⁱ Consider only antimony in the kala-azar of North China and the schistosomiasis of the Centre and South.

^j *CCIF*, ch. 22, (p. 265.2).

¹ 補虛除癰冷

² 益子精

³ 主泄精

Shih San¹ (powder of the five minerals),^a formerly named Han Shih San² (swallowed-cold powder). We also hear of a Wu Shih Kêng Shêng San³ (five minerals resurrection powder) and a Wu Shih Hu Ming San⁴ (five minerals life-preserving powder), all to be used in cases of sexual debility (*chang fu shuai Yang chhi chüeh*).^b This kind of thing had assuredly been going on for a very long time, no doubt since Shunyü I's – 2nd-century consultation with the unfortunate physician Sui (cf. pt. 3 below); and Ko Hung himself in his medical work *Chou Hou Pei Chi Fang*⁶ had devoted a special chapter (Chih Fu San⁷) to the dangers of poisoning when prostration and weakness in the male (*hsü lei*)⁸ was treated with the mineral formulae.^c Sun Ssu-Mo warned that young men who do not understand chemical purifications had better avoid either taking or prescribing these medicines.^d One formula, the Tzu Shih Han Shih San⁹ (purple mineral cold powder), was attributed by him to a Han source,^e the great physician Chang Chung-Ching.¹⁰ And such was his belief in the power of the metallic elements that Sun remarked: 'There have also been those who have acquired an addiction to the Five-Mineral preparations on account of their avidity for the pleasures of the bedchamber (*yu yu than erh wu shih i chhiu fang chung chih lo*).'^f Was it all due just to what we would call mild tonic actions on people with dietary mineral deficiencies?

China was certainly not the only civilisation to believe that arsenic had aphrodisiac properties; such a view long prevailed in the West. As a remedy for impotence, arsenic (as the trioxide) was accredited according to custom by Teste^g in 1854, and even (as iron arsenite) by Lauder Brunton^h in 1884; and there is ground for thinking that these and other arsenicals have been similarly prescribed in the present century. The first edition of Sollmann's authoritative treatise on pharmacology (1901) agreed that arsenic and phosphorus enjoyed some reputation as aphrodisiacs, but considered that if they were effective at all it must be through improvement of the general condition of the patient.ⁱ Wertheimer was certainly right in saying long ago (1895)^j that even very small doses of arsenic produce an urethritis, hence a tendency not only to erection but also dysuria, strangury and vesical tenesmus. The current view is that arsenic compounds produce a mild vaso-dilation in the initial stages here as elsewhere, but this is only the first sign of its potent toxic action on the capillaries.^k Degenerative changes follow in due course as the chronic stage of poisoning is reached, with local effusions,

^a This is also described, as a *tan*, in the +6th-century *Thai-Chhing Shih Pi Chi*, ch. 1, tr. Ho Ping-Yü (8).

^b CCIF, ch. 22, (pp. 260.2, 271.1).

^c Ch. 22, in ch. 3, (p. 82).

^d CCIF, ch. 22, (p. 261.1).

^e CCIF, ch. 15, (p. 167).

^f *Chhien Chin Yao Fang*¹² (Thousand Golden Remedies), c. +655, ch. 1, (p. 2.2); repeated by Chang Lu¹³ (+1617 to +1698), a millennium later, in his *Chhien Chin Fang Yen I*¹⁴, ch. 2, p. 5a.

^g (1), p. 219.

^h (1), pp. 641, 677, 1100.

ⁱ (1), p. 697. Cf. p. 649.

^j In Richet's *Dictionnaire de Physiologie*, vol. 1, p. 696.

^k Sollmann (1), 1st ed., pp. 602 ff.; Goodman & Gilman (1), pp. 944 ff.

¹ 五石散

² 寒食散

³ 五石更生散

⁴ 五石護命散

⁵ 丈夫衰陽氣絕

⁶ 肘後備急方

⁷ 治服散

⁸ 虛羸

⁹ 紫石寒食散

¹⁰ 張仲景

¹¹ 又有食餌五石以求房中之樂

¹² 千金要方

¹³ 張璠

¹⁴ 千金方衍義

oedema, loss of appetite, nausea, polyneuritis, muscular atrophy, and all kinds of pathological phenomena in skin, hair and nails.^a

It may be that the use of arsenic as an aphrodisiac in Europe was imported from India, for there it was traditional. Khory & Katrak^b in 1903 described it as a sexual stimulant; and Nadkarni^c as late as 1954 gave a classical formula of this type in which arsenic is combined in oil with plant material from *Calotropis* (= *Asclepias*) *gigantea*^d and the oleander *Nerium odorum*.^e The habit of giving arsenic in fevers may be a parallel, for it could also have come from there;^f it occurs both in the *Sūśruta Saṃhita* and the later alchemical works such as *Rasārṇava Tantra* (+ 12th century) and *Rasā-ratnasamuccaya Tantra* (c. + 1300).^g Rosinus Lentilius in + 1698 was the first to recommend this in the West, however,^g after which, as Fowler's Solution^h or Tanjore Pills, its use as an antipyretic can be found prescribed in therapeutic texts down to the early years of the present century.ⁱ The aphrodisiac use in Europe may well have started also in the + 16th or + 17th century, for earlier references seem to be very rare or even absent.

We need not follow the history of aphrodisiacs (*mei yao*¹) further here, and must in any case postpone the discussion of Chinese plant drugs believed to have such properties until we deal with pharmacological science in Sect. 45.^j But in order to place the medieval Chinese mineral elixirs in some sort of context it is just worth looking at the classification of the group. Fan Hsing-Chun has an interesting discussion of the means employed to stimulate sexual activity (*tshui yin*²) in different historical periods.^k The ancients of Chou and Han times, he said, relied upon perfumes (*hsiang*³), wine and beguilements (*chiu, yu huo*⁴); in Chin and Northern Wei the mineral mixtures (such as Han Shih San) were famous; Thang and Northern Sung people consumed especially the alchemical elixirs (*chin tan*⁵), generally mercurial and often doubtless arsenical. Then in the Southern Sung came the regular isolation of

^a The resemblance with the symptoms listed in the *Thai-Chhing Shih Pi Chi* passage just given (p. 283) is rather striking.

^b (1), p. 239.

^c (1), vol. 2, p. 18.

^d Nadkarni (1), vol. 1, p. 237. Another *Asclepias* species was used in China (R 166; CC 413).

^e Nadkarni (1), vol. 1, p. 847; cf. CC 428 and Liu Shou-Shan *et al.* (1), no. 147.

^f It was also ancient in China, as may be seen from *CLPT*, ch. 5, (p. 124.1), including much older references; and F. P. Smith (1), pp. 24-5, evidence for 1860-70.

^g See Schelenz (1), pp. 57, 478, 540. On the datings, Ray (1).

^h Arsenic trioxide in potassium hydroxide. It was still in the British Pharmacopoeia in 1953 but had dropped out by 1958.

ⁱ See, e.g., Lauder Brunton (1), p. 644; Sollmann (1), 1st ed., p. 609.

^j There is of course a large literature on aphrodisiacs in the West which may be approached in such publications as those of Davenport (1) edited by Walton; or Aigremont (1) and Cabanès (1). One curious reflection which arises is that if there was anything at all in the long-lasting and widespread belief in arsenic as a stimulant of this kind it might account for the equally venerable belief in the value of molluscs, crustaceans and echinoderms as food for the same purpose, found already in Juvenal (*Sat.* vi, 301; tr. Madan (1), vol. 1, p. 271), Plautus (*Casina*, ii, viii) and Apuleius (*Apologia sive de Magia*, xxvii ff.). For in fact these invertebrates do accumulate arsenic in their tissues to a far higher extent than any other edible animals, as the figures assembled in the review of Frost (1) show. It will be interesting to see whether this ancient belief was paralleled in the copious Chinese nutritional literature (Sect. 40 in Vol. 6).

^k (6), p. 42. He made an extensive study of the Chinese texts on aphrodisiac drugs.

¹ 媚藥

² 催淫

³ 香

⁴ 酒誘惑

⁵ 金丹

mixtures of steroid sex hormones (*chiu shih*,¹ *hung chhien*),^a much used in Yuan and Ming, while the Chhing afterwards succumbed to opium (*ya phien*).^b In all periods, of course, certain plant drugs were also commonly used.^c At the present time the purified sex hormones have almost completely superseded all other drugs for regulating sexual disorders, throughout the world, but it is interesting to ask what sorts of substances were formerly used both in East and West.^d As one can see from a relatively recent list,^e they divide into (a) the psychotropic agents, acting on the higher central nervous system, such as alcohol, cannabis and the opium alkaloids, (b) urethral irritants, either severe and dangerous, such as cantharides,^f or milder, such as a number of essential oils,^g and (c) spinal stimulants with a more or less specific action on the pelvic region, strychnine and nux vomica^h poorly so, yohimbine decidedly so.ⁱ All these do in fact work, by and large, but other agents that lingered on into modern medicine hardly had that justification.^j As for arsenic, it would have belonged to the second of the three classes.

On the authority of the Pharmacopocia Supplement to the *British Encyclopaedia of Medical Practice* (1967 ed.),^k a typical proprietary aphrodisiac preparation commonly

^a See further in Vol. 5, pt. 5, and also Sect. 45 below, in Vol. 6. Meanwhile the papers of Lu Gwei-Djen & Needham (3) and Needham & Lu (3) may be consulted.

^b This drug had been completely unknown in China before the 10th century, and was little used in medicine prior to the encouragement of the addiction by the Western merchants in the first half of the nineteenth century.

^c As if by an oriental version of the doctrine of signatures some phalloid plants were among them. The *so yang*⁴ or *shê ku*⁵ was *Cynomorium coccineum* (= *Balanophora dioica* = *japonica*) of the Balanophoraceae (R 240; CC 1565, 1566), on which see Stuart (1), p. 61. This was the plant which was supposed to grow wherever wild horses shed their semen, and that was one of the stories which Li Shih-Chen about +1590 treated with appropriate scepticism; PTKM, ch. 12, (p. 110).

^d There is a useful survey in Japanese, the book of Kawabata & Yoneda (1).

^e B.P. Codex, 1934, p. 1620.

^f A crystalline lactone from the famous 'Spanish fly' or 'blistering beetle', *Cantharis vesicatoria* (Coleoptera), which acts as an aphrodisiac by reflex irritation from the urethral mucous membrane (Sollmann (1), 8th ed., p. 161). One of the best accounts of the drug is that of Pereira (1), vol. 2, pp. 1834 ff. It is worth recording that China had a closely parallel medicament, from different beetles, *Mylabris sidae*, *M. cichorii* and *M. pustulata*; this was the *pan mao*⁶ noted already in the *Pên Ching* two millennia ago (R 29; F. P. Smith (1), p. 153; Anon. (57), vol. 4, pp. 190 ff. There is an illustration in CLPT, ch. 22, (p. 448.2).

^g E.g. damiana, mint, camphor, and of course the Chinese *Panax ginseng* (*jen shen*?). Damiana is from *Turnera diffusa*, a North and Central American plant, mint from *Mentha piperita*, allied to Chinese *Mentha arvensis* (R 129; CC 337).

^h The dried ripe seeds of *Strychnos Nux-vomica* (Loganiaceae); R 175, CC 447. The alkaloid of greatest importance from them was not described in the West till +1540. All reflexes are increased with strychnine, and it was thought to raise the tone of the spinal centres connected with the genital organs, but this is very doubtful (Sollmann (1), 8th ed., pp. 232 ff.).

ⁱ An alkaloid from the bark of an African tree, *Pausinystalia yohimba* (Rubiaceae). It certainly does increase specifically all pelvic reflexes, and has a vasodilatory action on the genital organs (Meyer & Gottlieb (1), p. 253), but no effect either on libido or on spermatozoa production (Sollmann (1), 8th ed., p. 342). Probably this local vaso-dilation was the way in which most of the unspecific agents, if effective, worked.

^j Perhaps the use of gold chloride against the decline of the sexual powers, accepted by Lauder Brunton (1), pp. 680, 1100, as late as 1885, might be thought one of the most remarkable Western survivals of the alchemical dream. For lupus and arthritis, gold salts, organic gold and colloidal gold are given still.

^k Anon. (92), p. 669.

¹ 秋石

² 紅鉛

³ 雅片

⁴ 鎖陽

⁵ 蛇菰

⁶ 斑蝥

⁷ 人參

prescribed at the present day adds yohimbine and a little strychnine (together with dexamphetamine and amylobarbitone) to a steroid sex-hormone, methyl-testosterone. But it is interesting to find that while in the 1961 edition it relied entirely on yohimbine and strychnine without any hormone,^a in the 1957 edition it contained arsenic trioxide as well.^b From this we may see at how recent a date the use of arsenic for impotence and sexual debility was abandoned.^c Perhaps its final demise rested not so much on a conviction of ineffectiveness as on a reluctance to risk the use of such a violent poison even in small doses and initial stages of therapy.

If medical science in recent times has hesitated to confirm belief in any strong specific aphrodisiac powers of arsenic, this element could still have done much for the elixir-takers (in the early stages of its action) by its classical effect as a 'tonic' or 'alterative'; an effect which has never been disputed, though few indeed would venture so to prescribe it nowadays.^d Within the last half-century arsenic in small doses has been regarded as an agent improving appetite and zest without increasing hunger (though this soon passes, and aversion to food ensues as the element accumulates in the body);^e it has also been thought to increase growth-rate and weight (for a time), and to stimulate the bone-marrow, raising the erythrocyte count.^f All these phenomena, while not denied, are now believed to be simply the earliest manifestations of the toxic action, undoubtedly involving mild splanchnic hyperaemia.^g The Indians still remain convinced of the safely tonic value of arsenic, however, as may be seen from all their modern materia medica treatises.^h And not only the Indians, for the 1937 Gehes Codex of German proprietary medicines devotes no less than eight pages to tonic compositions containing arsenic in various forms.ⁱ With this the case is virtually proved—the element arsenic could indeed have been a bait for the disciples and patients of the medieval Chinese Taoists.

Once this is realised other elements come into the same picture. A pharmacological textbook of 1901 could say that 'very small doses of mercury may have the same beneficial effects on metabolism as small doses of arsenic, and probably in much the same manner. The patient may increase in weight, the number of red blood corpuscles may rise, etc.'^j Similar beneficial effects in dyspepsia, scarlatina, mumps, jaundice and

^a Anon. (92), p. 680. Cf. Martindale (1), pp. 1555-6.

^b Anon. (92), p. 472. In the 1953 edition this particular preparation was not listed at all, but others no doubt then still included arsenic.

^c In Germany it seems to have gone earlier. Many aphrodisiac compositions are given in the Gehes Codex for 1937 (Anon. (93), pp. 1315-16), but none with arsenic.

^d The famous case of the Styrian peasants, who take, or used to take, arsenic habitually to increase their energy, has been thought to imply some kind of tolerance or immunity (Lauder Brunton (1), p. 643). Whatever this was, it might perhaps have led to a prolongation of the resistance, and hence ultimately the agonies, of the medieval Chinese elixir-takers. But the arsenic has to be taken in some insoluble form, and the intestinal walls come to absorb very little of it (Clark (1), p. 608).

^e Martindale (1), p. 138.

^f On all these effects see Whitla (1), p. 294; Lauder Brunton (1), pp. 317, 644; Sollmann (1), 1st ed., pp. 602ff., 605, 609; Goodman & Gilman (1), p. 946; Frost (1).

^g Goodman & Gilman, *loc. cit.*; Sollmann (1), 1st ed., p. 604, 8th ed., p. 1204.

^h From Ainslie (1), vol. 1, pp. 498ff., 640, onwards, e.g. Khory & Katrak (1), p. 239 and Nadkarni (1), vol. 2, p. 18 as late as 1954.

ⁱ Anon. (93), pp. 116-24. And a parallel statement could be made for Britain also.

^j Sollmann (1), 1st ed., p. 634. For a modern survey see Passow, Rothstein & Clarkson (1).

'biliousness' were described as classical in the nineteenth century,^a when the 'blue pills' of Mr Abernethy were freely prescribed, as for that 'morning after' feeling. Yet mercury was never considered so clearly 'tonic' and 'alterative' as arsenic. One point however should make us pause, its powerful and universally recognised stimulation of salivation;^b for as we shall later see, the swallowing of saliva was one of the cardinal important techniques of the *nei tan* adept, i.e. the physiological, as opposed to the chemical, alchemist, in medieval China.^c A similar salivary stimulus occurs with lead, another metal only too likely to have participated in the metallic elixirs, though highly toxic after a short while.^d The *wai tan* elixirs must therefore have provided a copious supply of the secretion so much desired by the *nei tan* adepts. A parallel argument is applicable to that other secretion, semen, which (as we shall later find in Vol. 5, pt. 5) was of such vital importance for the physiological alchemists, whether Taoist, Tantric, or 'psychologised' as in later syncretic Buddho-Taoism. Though in all probability neither arsenic nor any of the plant aphrodisiacs, nor even the mineral tonics, really did anything to stimulate the production of spermatozoa by the testes, their effects on libido and potency were doubtless sufficient to assure the adepts that the secretion was not in short supply.^e Of course when in the Sung period mixtures of steroid sex-hormones and gonadotrophins did become available (anticipating in a way the European discoveries by nearly a whole millennium), the Chinese alchemists and physicians were in possession of something which could stimulate the sexual functions in a really natural manner; but as we shall later show, this development was itself the result of a synthesis of physiological with chemical alchemy. At any rate it probably had the happy result of reducing to some extent the reliance of the elixir-takers on the metallic compounds of arsenic, mercury, gold, silver and lead. But one metal there was which could be said to be reliably 'tonic' without much danger, iron, and this the Chinese alchemists and iatro-chemists well knew.

When I was a boy I remember being given the bitter ferruginous tonic of iron, quinine and strychnine.^f A lot more fuss was made sixty years ago about the necessity of 'tonics' (and also about 'bracing' and 'relaxing' climates) than it is now, in these days of more than adequate vitamin supplies and supplements, with a generally much higher standard of nutrition. But that ought to remind us of something valid and important for the whole argument of this sub-section, namely that we cannot judge the pharmacological needs and practices of communities on sub-standard diets in ancient and medieval times (as also of course in the less developed regions of the world today)^g

^a Lauder Brunton (1), pp. 618ff.

^b Sollmann (1), 1st ed., p. 633; Lauder Brunton (1), p. 616; Martindale (1), p. 762.

^c See Vol. 5, pt. 5.

^d Sollmann (1), 1st ed., p. 641.

^e This was needed, as we shall later see, not so much for emission as for the production of the internal elixir or enchymoma.

^f 'Easton's Syrup', based on ferrous phosphate (B.P. Codex, 1934, p. 459; Sollmann (1), 1st ed., p. 625). 'Parrish's Food (or Syrup)' is a similar preparation without alkaloids, adding only calcium phosphate and sucrose (B.P. Codex, 1934, p. 457; Lauder Brunton (1), p. 677). Sollmann, *op. cit.* p. 613, remarked that on injection iron 'produces effects which resemble those of arsenic very closely'; cf. p. 622 on the action on the bone-marrow.

^g How much can one not read between the lines in the remark of Lauder Brunton (1), p. 676, a hundred years ago, that ferrous iodide 'is thus very useful in . . . dispensary practice in large cities, where

in the same manner as is customary within affluent and well-nourished societies. Not only were there many dietary deficiencies, in spite of the advanced knowledge contained in the old Chinese nutritional literature (cf. Sect. 40), but also many very widespread chronic infestations, especially by the intestinal helminthic worms.^a The needs of ancient and medieval societies were truly different from those of our own, and far graver; and much that may seem strange about elixir alchemy has to be thought of in this context.

Accordingly it is of special interest to find whole books in the Chinese medieval literature devoted to preparations of iron for alchemical-pharmaceutical use. The *San Shin I Shen Pao Ming Shen Tan Fang*¹ (Efficacious Elixir Prescriptions of Three Grades Inducing the Appropriate Mentality for the Enterprise of Longevity)^b cannot be later than +1020 for it was edited by Chang Chün-Fang,² and probably dates from some time in the Tang period. The essence of the book consists in arrangements for obtaining purplish-red ferric oxide by the rusting of plates of good steel in brine under controlled conditions,^c then administering it in complex prescriptions with plant and other materials, so that small amounts of other more absorbable salts (such as citrate, malate or acetate) may have been formed. The main product was called *thieh yin tan*,^{3,4} *yin* here meaning the 'spontaneous successor' or 'posterity' of iron. Plant drugs, says the introduction,^d give quick results but not lasting ones, while mineral and metallic drugs are slow in action but very long-lasting, yet they contain dangerous poisons, causing violent headaches, or ulcers and carbuncles on the back, for which antidotes have to be taken—only with *thieh yin tan* there is never anything of this kind to fear. It strengthens the muscles, makes pain endurable, brightens the eyes, calms the mind, fortifies the brain and marrow, smooths the skin, keeps the hair black, makes abstinence from cereals easier, enhances the memory, and 'quietens and confirms the *hun* and *pho* souls'.^e In other words it is a tonic of the first order, and the anonymous writer would have been happy to add an improvement of haemoglobin levels and erythrocyte count, if he had known of them. It can be taken for years without ill-effects.^f But what is particularly interesting is the repeated statement that the effects upon sexual urge and activity are so strong as to be embarrassing (*hêng pu wei hsieh*),^g indeed they have to be combated by the addition of anti-aphrodisiac plant drugs (*i hsin li pu chhiang*

pale, anaemic, flabby and scrofulous children abound, and come in great numbers to be treated'. He combined it with cod liver oil.

^a In this connection one must not overlook the fact that besides the relatively safe plant anthelmintics, which the Chinese were among the first to recognise, iron and mercury have been considered useful in various ways for the same purpose (Sollmann (1), 1st ed., p. 739; Lauder Brunton (1), pp. 357-8, 672, 1117), and might therefore have been beneficial.

^b In YCCC, ch. 78, pp. 1a ff.

^c Pp. 4b ff., 31a ff.

^d P. 1b. The statement is very just, if one contrasts the immediately startling effects of a powerful alkaloid with the slow accumulation of a toxic metal, not easily reversible.

^e P. 2a, b. It also protects against epidemic infections, and helps one to become a celestial immortal (p. 10a). On the *hun* and *pho* 'souls' see p. 85 above.

^f P. 3a. Furthermore it gives good looks to sexually unattractive people (p. 15a).

^g Pp. 3b, 9b, 10a.

¹ 三品頤神保命神丹方

² 張君房

³ 鐵微丹

⁴ 鐵嵐丹

⁵ 莫不委歟

*Yang tao*¹).^a This record of experience is valuable because it demonstrates that on sub-standard diets even so simple a tonic as iron would restore libido and potency to normal levels; hence the alchemists could have commended their elixirs to the unwary not only with arsenic and mercury but even with iron.

As for the date at which all this started, the *San Phin I Shen Pao Ming*. . . *Fang* was far from the beginning of it. Very similar processes are described in the *Thai-Chhing Shih Pi Chi* (Records in the Rock Chamber) already mentioned,^b some of which will be as old as the late +3rd century, though finally assembled and finished in the +6th. For example, two plates of steel, one round and one rectangular,^c are mounted on an iron rod centrally and immersed in vinegar and wine with pepper, ginger, magnetite powder and much salt, then buried in a pottery jar for 150 days, fresh brine being added daily.^d Presumably a mixture of ferric oxide (*thieh hsiu*²), ferrosferric hydroxide (a form of *thieh lo*³), and ferrous acetate (*thieh hua fên*⁴), with other salts of iron besides, was formed.^e In another formula iron acetate was obtained by heating filings of wootz steel (*pin thieh*⁵) with strong vinegar.^f The 'purple' colour eventually appearing must imply the formation of the deep red solution of ferric acetate and basic ferric acetate, still used as a mordant,^g and until recently in medicine.^h The Chinese did not give the acetate alone, but in combination with plant and other drugs.

Thus, to sum it all up, we must conclude that among the metallic and mineral components of the ancient and medieval Chinese elixirs there were some which could, and indeed did, exert a beneficial influence on the body and mind of the aspirant to immortality, especially under the prevailing conditions of nutritional deficiencies and parasitic infestations. Of these the action of some, like iron, was without danger, but only too many, such as arsenic and mercury, had results that were but the hopeful prologues to chronic intoxication. Belief in the attainment of material immortality was thus analogous to that blind phototropism which drives the insects of the summer night to perish in the flame of the lamp.

(2) TERMINAL INCORRUPTIBILITY

That seeming death, or a trance of temporary death, or in some sense actual death, might be a necessary gateway to Taoist immortality, was certainly believed at various times in the development of Chinese alchemy. This one can see from the legend of

^a Pp. 3b, 6b ff. Rules are also given for frequency of sexual intercourse at different ages and under this medication (pp. 10a, 19a, 30b, 31b).

^b TT 874.

^c Perhaps a piece of cosmic sympathetic magic, the heavens being round and the earth square (cf. Vol. 3, pp. 212-13, 220).

^d Ch. 2, p. 6a, b, tr. Ho Ping-Yü (8), pp. 59-61.

^e RP 22, 23, 24, 25; cf. Partington (10), pp. 856 ff. and F. P. Smith (1), pp. 121-2.

^f Ch. 3, p. 1a, tr. Ho Ping-Yü (8), pp. 75-6. On *pin thieh* see Needham (32), pp. 44 ff., and Vol. 5, pt. 1, 'Wootz' (Indian crucible steel), from Canarese *ukku*, first in English +1795.

^g Sudborough (1), p. 151.

^h Lauder Brunton (1), p. 671; Sollmann (1), 1st ed., p. 625. Cf. F. P. Smith (1), p. 122.

¹ 益心力不强陽道

² 鐵鏽

³ 鐵落

⁴ 鐵華粉

⁵ 鐵鐵

Wei Po-Yang,¹ the +2nd-century adept to whom we shall presently devote a special sub-section (in pt. 3). The +4th-century *Shen Hsien Chuan*² tells how Wei Po-Yang, a recluse of Wu,

passed into the mountains to prepare numinous elixirs. With him went three disciples, two of whom were, he felt, lacking in complete faith and sincerity. When the elixir was achieved he decided to make a trial of them. 'The gold elixir is now made', he said, 'but it ought first to be tested. Let us give it to this white dog; if the animal (lives and) can soar into the air then it will be safe for human beings, but if the dog should die then it is not to be taken.' The dog was one which they had brought with them into the mountains. If the number of cyclical transformations in the process had been insufficient, or the harmonious combination of the ingredients unsuccessful, the elixir would have been poisonous, and whoever consumed it would die at once.

So (Wei) Po-Yang fed it to the dog, and the dog immediately fell down dead. Turning to the disciples he said: 'I fear the elixir was not perfected. As it has killed the dog it would seem that we have not grasped the full theory of spiritual power. If we take it now I am afraid that we shall go the same way as the animal. What do you think we should do?' The disciples, perplexed, replied by another question: 'Would you, Sir, dare to take it yourself?' He answered: 'I abandoned worldly ways and forsook family and friends to enter into the mountains; I should be ashamed to return without having found the Tao of the Holy Immortals. To die of the elixir would be no worse than living without it. I must take it.' And he did, whereupon no sooner was it in his mouth than he fell dead. . . .

On seeing this one of the disciples said: 'Our teacher was no ordinary person; what he has done he did with intention', so he too swallowed the elixir and died. Then the other two said to one another: 'Those who prepare elixirs do so to gain immortal life (*chhang shêng*).³ But now this elixir has brought death. It would be better not to take it, and live in the world a few more decades instead.' So together they left the mountains, intending to get coffins and other things for the burial of their teacher and fellow-disciple.^a

After they had gone (Wei) Po-Yang revived, and so did the disciple (whose name was Yü⁴), and so did the white dog; and they all went away further into the mountains (to tread the path of the immortals). On the way they met a wood-cutter by whom the Master sent a letter to the two disciples thanking them for their kindness. But when they read it their hearts were filled with grief and regret.^b

This famous story is worth reproducing not only for its clear evidence of the idea of animal experimentation in the +4th century,^c but also because of the conception of 'temporary death' as the portal of everlasting life. A Thang text says that an elixir which it describes takes from seven days to a year to make the adept immortal, depending upon his quality, doses half the size of a millet-grain being taken regularly. But it adds:

If one is sincerely determined, and dares to take a whole spatula-full all at once, one will temporarily die (*tsan ssu*)⁵ for half a day or so, and then be restored to life like someone

^a A particularly nice Confucian touch.

^b Text in YCCC, ch. 109, pp. 5a-6a, tr. auct., adjuv. Wu Lu-Chhiang & Davis (1) from *Lieh Hsien Chhuan Chuan*. Often quoted, as by J. Read (1), p. 122. Cf. Fig. 1329.

^c And therefore probably also the practice. Cf. below, pt. 3.

¹ 魏伯陽

² 神仙傳

³ 長生

⁴ 虞

⁵ 暫死

waking from sleep. This however is perilous in the extreme. One is better advised to limit oneself to the half-millet-grain doses as specified in the instructions.^a

Similar ideas are constantly found. The preparation, probably from a hallucinogenic and toxic mushroom, by which Chou Tzu-Liang¹ effected his translation to the unseen world in +515, was called the Nine-times Perfected Jade Drops Elixir (*Chiu chen yü li tan*).² Of this the commentary, presumably Thao Hung-Ching's, says:^c

If you should desire to ascend to the heavens with all speed, the elixir is to be swallowed in a single dose; you will fall prostrate and die immediately. But if you wish to prolong your stay among men, you are to consume it little by little, and when at last it has all been taken, you will then too find yourself an immortal. . . .

Again, in one of the documents collected by Thao Hung-Ching just before +499 in that book of revelations called *Chen Kao*³ (Declarations of Perfected Immortals), we can read the following strange passage, quoted from some document attributed to Mao Ying⁴ of the -1st century (cf. p. 235).^d

Those who feigned residence in a constructed tomb after swallowing Lang-kan blossoms (*lang-kan hua*)^e were Hsienmên Tzu⁶,^f Kaochhiu Tzu⁷ and Master Hung Yai⁸. . . . People who live in the three counties where their sepulchres are all call them 'vacant tumuli of the dead of highest antiquity'. But they do not realise that on another occasion Kaochhiu Tzu entered Mt Liu-ching as a corpse-free immortal,^g afterwards consuming powder of liquefied gold, and then still more Lang-kan blossoms at Chung Shan, so that he feigned the appearance of still another death. Thereupon at last he entered the land beyond (*hsüan chou*).⁹

Those who died directly they had consumed 'dragon-embryo' (*lung thai*)¹⁰ or drunk 'jade essence' (*chhiung ching*)¹¹ and then could rap on their coffins, were my old teacher Lord Wang of the Western Citadel (Wang Hsi-Chêng¹²), Chao Po-Hsüan¹³ and Liu Tzu-Hsien.¹⁴

Those who declared that their end was nigh after they had taken the gold elixir were Tsang Yen-Fu,¹⁵ Chang Liang¹⁶,^j and Mo Ti Tzu¹⁷.^k

^a TT 878, ch. 20, p. 17a, tr. auct.

^b Unless *chiu chen* is a kenning for a fungus. The reference is *Ming Thung Chi*, ch. 4, p. 19a, b.

^c Tr. Strickmann (2), p. 25. On Chou Tzu-Liang see p. 110, fn. e.

^d TT 1004, ch. 14, pp. 16a ff., tr. Strickmann (2), pp. 5-6.

^e Probably a reference to some poisonous mushroom or toadstool coloured red or green. *Lang-kan* is one of the most elusive terms in Chinese mineralogy, used at various times for coral, the balas ruby, malachite and other things (cf. Chang Hung-Chao (1), pp. 26 ff.).

^f Cf. p. 96 and Vol. 2, pp. 133-4. Correctly, *hsien*.¹⁸

^g On this concept cf. p. 302.

^h The nature of this is not known, but it occurs elsewhere in the *Chen Kao* (e.g. ch. 3, p. 15b, ch. 6, p. 2b) and in the biography of Master Phei (*YCCC*, ch. 105, p. 8b, cf. Vol. 5, pt. 5), as Strickmann has found. One suspects a cryptogam again.

ⁱ Also unknown, but it need not mean red jade, since the term was applied not only to coral and jasper but to a certain plant associated with immortality and sometimes identified as a *Hortensia*. We discuss this in detail in Sect. 38. On the other hand it could easily have involved a red fungus.

^j The Taoist statesman, d. -187. Cf. pt. 3, and Vol. 2, p. 155.

^k The philosopher of universal love, transmuted to an alchemist, cf. Vol. 2, p. 202. Properly Ti.¹⁹

¹ 周子良

² 九真玉液丹

³ 真誥

⁴ 茅盈

⁵ 琅玕花

⁶ 衛門子

⁷ 高丘子

⁸ 洪涯先生

⁹ 玄州

¹⁰ 龍胎

¹¹ 瓊精

¹² 王西城

¹³ 趙伯玄

¹⁴ 劉子先

¹⁵ 臧延甫

¹⁶ 張良

¹⁷ 墨狄子

¹⁸ 羨

¹⁹ 瞿

Those whose corpses began to stink as soon as they had taken the Nine-times Cyclically Transformed (elixir), and from whose bodies the maggots streamed when they had swallowed only a spatula-full, were Ssuma Chi-Chu¹,^a Ning Chung-Chün²,^b Prince Chao of Yen (Yen Chao Wang³),^c and Wangtzu Chhiao⁴.^d

Here then we have such alternatives as disappearing into thin air, and even doing it several times, seeming to die yet retaining some activity after burial, dying and clearly decomposing, or dying yet never decaying. The confidence with which alchemists of all the traditions emanating from the Chinese could ingest lethal poisons^e was very much in the mind of Martin a century ago when pioneering the present study,^f and has more recently been emphasised in an Indo-Arabic context by Mahdihassan.^g

But even when the unmistakable death of the elixir-taker supervened, all was not necessarily lost for the doctrine. If the corpse was preserved from natural decay, in recognisable identity, that was a wonder in itself; almost a proof indeed that the adept was living on as one of the immortals, having taken with him a sufficient simulacrum of his bodily appearance to keep the constituent spirits and 'souls' in union together. This would be one kind of 'announcement of immortality' (*kao hua*⁵), or 'release from the mortal part' (*shih chieh*⁶). Or perhaps he was just sleeping, and made use of the uncorrupt body, in full animation, when the Taoists and their disciples were not viewing it. That would be one form of 'taking flight to attain the state of immortality' (*yü hua*⁷). There were many terms and phrases of this kind, some twenty occurring in the *Li Shih Chen Hsien Thi Tao Thung Chien*⁸ (Comprehensive Mirror of the Embodiment of the Tao by Adepts and Immortals throughout History), a vast compilation,^h probably made in Yuan times, by Chao Tao-I.⁹ One thing is certain, or at least constantly averred, namely that the bodies of some alchemical adepts did not decay. For example, in the *Hsü Hsien Chuan*¹⁰ (Further Biographies of the Immortals), a work written by Shen Fên¹¹ between +923 and +936, it is related that when Sun Ssu-Mo¹² died in +682 at the age of a hundred or slightly more, no visible sign of putrefaction was noticed during a period of many weeks. 'After more than a month had passed there was no change in his appearance, and when the corpse was raised to be placed in the coffin it was as light as (a bundle of) empty clothes. Truly this was release from the mortal

^a Diviner in the Early Han, d. c. -170.

^b Possibly the semi-legendary Ning Fêng Tzu,¹³ mentioned already in Vol. 4, p. 2, p. 44, and more fully discussed in Kaltenmark (2), pp. 43 ff.

^c R. -311 to -278. Already prominent in the search for immortality drugs; cf. p. 97 above, and the classical passage quoted in pt. 3 below.

^d Semi-legendary crown prince of Chin State c. -550. He was adopted as a Taoist patron saint of macrobiotic gymnastics and of the art of the mariner's compass, deified, too, as Comptroller of the Hua kai Constellation. Cf. Fig. 1307 above.

^e Cf. the cases of Hsü Hui and Chou Tzu-Liang discussed on p. 110. They belonged precisely to the Mao Shan school in which the *Chen Kao* was produced.

^f (8), in (3), vol. 2, pp. 224 ff. He even gave an American example of 1877.

^g (17), pp. 72, 78.

^h TT293.

¹ 司馬季主

² 寧仲君

³ 燕昭王

⁴ 王子喬

⁵ 告化

⁶ 尸解

⁷ 羽化

⁸ 歷世真仙體道通鑑

⁹ 趙道一

¹⁰ 續仙傳

¹¹ 沈汾

¹² 孫思邈

¹³ 寧封子

part.^a As Ho Ping-Yü & Needham remarked,^b possibly this great +7th-century alchemist, physician and pharmacist had taken one of the many elixirs containing arsenic or mercury described in his own work *Thai-Chhing Tan Ching Yao Chüeh*¹ (Essentials of the Elixir Manuals for Oral Transmission...), or *Thai-Chhing Chen jen Ta Tan*² (The Great Elixirs of the Adepts...), written about +640. The doses of metallic substances recommended here,^c such as mercury, gold, and the arsenical sulphides, are generally much more drastic than in Sun's own medical books.^d

There were three ways in which such freedom from decay could happen. First it is a commonplace among experts in forensic medicine that putrefaction is to a great extent inhibited in victims of poisoning by metallic compounds,^e and especially by arsenic. In his authoritative work Glaister says that 'the preservative influence of arsenic upon the tissues of those poisoned by this substance has been repeatedly observed, and noted following exhumation, despite assertions to the contrary'.^f Presumably the bacteria themselves are poisoned by the arsenic. It is thus more than likely that the bodies of those who died from elixir poisoning remained comparatively undecomposed, and this could be adduced by the Taoists as one more piece of evidence for the efficacy of their chemistry. In such cases the features would be well preserved and the body would have a natural look, with little or no odour of decay.

Other possibilities have also to be considered, however. The decomposition of dead bodies is promoted by air and retarded or inhibited under anaerobic conditions.^g It also goes on very slowly or not at all both below 10° C. (a condition which would hardly have pertained in China),^h and above 38° C. because the fluids dry up and mummification is likely to ensue (an environment which could probably have occurred in South China).ⁱ Any very dry conditions retard decomposition, and mummify, apart of course from the specific desiccatory processes of the ancient Egyptians already mentioned (p. 75 above); and here a current of warm dry air helps.^j The skin turns brownish-

^a YCCC, ch. 113, p. 20a. Almost identical words occur in *Chiu Thang Shu*, ch. 191, p. 10a, tr. Sivin (1), p. 130.

^b (4), p. 236.

^c See e.g. YCCC, ch. 71, p. 9b. Tr. Sivin (1), p. 184.

^d Cf. pt. 3 below.

^e Metallic mercury can undoubtedly be used as a preservative, even for those who have not been poisoned by it. There was mercury in the tomb of Chhin Shih Huang Ti (cf. Vol. 3, p. 582), and in Szechuan bodies buried in Ming times have been found very well preserved in cedar-wood coffins, with lime around them like a desiccator, and perfumed mercury in the abdomen; cf. Liu Shih-Chi (1), Demiéville (8). Other Szechuanese mummies have been described by Kung, Chao, Pei & Chang (1).

^f (1), 1st ed., p. 419, 7th ed., p. 479, 12th ed., p. 513. In the case described by Whitford (1) 37 months of burial led to very little changes in the bodies (1884).

^g As for example in the famous cases of well-preserved neolithic or aenolithic bodies in the bogs of Denmark. Cf. p. 304.

^h Though it does explain the persistence of the flesh of extinct mammoths, even with skin and hair intact, in the frozen Siberian soils. Similar refrigeration naturally conserves the bodies of alpinists in crevasses. On the conditions for decomposition see Glaister (1), 1st ed., pp. 115ff., 7th ed., p. 128, 12th ed., pp. 119ff.

ⁱ A number of European examples are cited by Demiéville (8), all monastic—the Eremitani at Palermo, the Capuccini at Rome, St John of Rila in Bulgaria (cf. Hristov, Stojkov & Mijatev (1), pp. 12ff.), and the Basilians of the Poščevskaia Lavra at Kiev.

^j Glaister (1), 7th ed., p. 132, 12th ed., pp. 124-5.

¹ 太清丹經要訣

² 太清真人金丹

black, the muscles shrivel yet the anatomical features are well preserved, and the less fat the body contains the more hard and odourless the mummy will be.^a

There is however a third possibility, for under semi-anaerobic conditions of high temperature and moisture, relatively free from bacteria, a far-reaching hydrolysis and hydrogenation of the fats may outstrip the processes of bacterial attack on the proteins, giving rise by saponification to calcium, ammonium and other salts of higher fatty acids, and hence the production of a waxy substance known as adipocere. This has a mouldy cheesy smell, but when the process occurs the body's features are remarkably maintained.^b It has not been possible in modern times to bring this about designedly, but that can hardly prove that it has never been possible. Once again it would have allowed the Taoists to say that the adept, still perfectly recognisable as if in slumber, had joined the ranks of the immortals.

But how to defy corruption at will? Stories of self-mummification in the literature have been verified and illumined of late by the researches of Andō Kōsei (1, 2) and Hori Ichirō (1, 1, 2), who discovered a living tradition of it in Japan.^c The adept towards the end of his life abstains for a long time from all cereal food,^d living only on plant material such as chestnuts, *Torreya* nuts,^e pine-tree bark or the roots of grasses; then just before death he may claim the distinction of being buried alive. After death has occurred the corpse is dried over charcoal fires and smoked with the fumes of incense, then when fully desiccated lacquered all over or used as the base for a statue of dried clay or plaster. The 'self-mummified Buddhas' of the Shingon¹ school studied by Hori and Andō were all 'mountain monks' (*yamabushi*²)^f practising a life-time of religious austerities (*isse-gyōnin*³); and they belonged to the *shugen-dō*⁴ or 'mountain asceticism' cult, which was supposed to aim at combining Buddhism and Shintoism.^g Six mummies of these *sokushin-jōbutsu*⁵ saints ('becoming a Buddha in one's own body') are still preserved at five temples in Yamagata⁶ province at Yudono-san,⁷ and the personal histories of eight altogether are rather precisely known. The first was Kōchi Hōin⁸ who died in +1363, the most recent Tetsuryū-kai Shōnin⁹ (1868 or 1881).^h Of the others, two were of the +17th century, two of the +18th, and two of the early nineteenth.ⁱ Since the *shugen-dō* school goes back a thousand years earlier there must have been many more such mummies, lost perhaps, or not yet investigated. Its traditional founder was En-no-Shōkaku¹⁰ (+634 to c. +700).^j

^a Moreover, mummification is said to be induced more readily if arsenic is present; Glaister (1), 1st ed., pp. 113-14.

^b On saponification see Glaister (1), 1st ed., pp. 111-12, 7th ed., p. 132, 12th ed., pp. 124-5.

^c See also the collection of studies in Anon. (103).

^d Except perhaps a little buckwheat. This is not a cereal, strictly speaking, for us either, being Polygonaceous.

^e The fruits of a Taxaceous tree, *fei shih*¹¹ (*T. nucifera*), not far removed from the yew. Cf. F. P. Smith (1), p. 220.

^f Cf. Casal (1); Schurhammer (2).

^g Cf. Hori Ichirō (2); Renondeau (1).

^h Shōnin was a title given to eminent Buddhist monks.

ⁱ Detailed anatomical studies have been made by Ogata Tamotsu (1).

^j Cf. Vol. 5, pt. 3.

¹ 眞言

² 山伏

³ 一生行人

⁴ 修驗道

⁵ 即身成佛

⁶ 山形

⁷ 湯殿山

⁸ 弘智法印

⁹ 鐵龍海上人

¹⁰ 役小角

¹¹ 榲桲

then it was led by the monk Shōbō¹ (+832 to +909); and the great monk Kūkai² (Kōbō Daishi,³ b. +774), by tradition the inventor of the *hiragana* syllabary, who was in China from +804 to +806, is alleged to have died self-mummified in +835.⁴

There is some difference of opinion as to whether self-mummification (*chen shen*,⁵ *jou shen*⁶) was originally Taoist or Buddhist. Hori Ichirō believes in a Taoist origin,⁷ but Demiéville (8) emphasises that the practice was much more common among the Buddhists, at least after the Chin period. We incline, however, to the former opinion, partly because the abstention from cereals (*pi ku*,⁸ *chüeh ku*,⁹), and the custom of consuming all kinds of unlikely vegetable and mineral substances (*mokujiki-gyō*¹⁰), are such constant characteristics of early Taoist hagiography (see Vol. 5, pt. 3 below). There is no dispute that the Taoist Shan Tao-Khai⁹ of Tunhuang, who died at Canton in +359, carried out a self-mummification;¹¹ he was said to have left off cereals for seven years and lived only on cypress cones and pine resin. These things indeed were precisely among the 'foods' recommended about +670 by Sun Ssu-Mo, including also the *fu-ling*¹⁰ fungus,¹² other conifer resins, pine and cypress seeds, and mica powder, made up into jams or pastes with white honey and date pulp.¹³ From the +5th century onwards, Andō (1) has been able to record more than fifty cases of self-mummification, nearly all Buddhist, among which are the great founder of the Thien-Thai¹¹ school, Chih-I¹² (d. +597 or +598), and the Indian Tantrist Śubhakarasiṃha (d. +735). An outstanding example would be that of Hui-Nēng,¹³ the sixth and last Chhan¹⁴ patriarch (d. +713), whose lacquered mummy can still be seen at the Nan-Hua¹⁵ temple at Tshao-chhi¹⁶ near Chiu-chiang (Kukong).¹⁷ This is reproduced in Fig. 1330, taken from Lo Hsiang-Lin's account (3) of the famous Kuang-Hsiao¹⁷ temple in Canton with which Hui-Nēng was so prominently connected. What is still more striking is that self-mummification seems to have been practised even later in China than in Japan. Maspero (31) has described the death of a Buddhist monk, Jen-Kuang,¹⁸ in this fashion, on Phu-tho¹⁹ Island, where the lacquered mummy was kept as an object of devotion, as late as 1904. Another, Ching-Tshan,²⁰ appears, according to Demiéville, to have made the same end on Taiwan in 1927, and a further instance, still more recent, was that of Tshē-Hang²¹ at Taipei in 1954—upon the opening of his jar in 1959 no corruption of the thin dry corpse was found, so the body was duly lacquered and installed in the temple.²²

^a A memorable visit was paid to Kōbō Daishi's tomb on Kōyasan²² by Dr Lu Gwei-Djen, Dr Dorothy Needham and myself in the summer of 1971, accompanied by Professor Nakayama Shigeru, Professor Shinoda Osamu and Dr Hashimoto Keizō.

^b (1), p. 239.

^c He was one of the few Taoists to gain a place in the *Kao Seng Chuan*²³ (Lives of Eminent Monks).

^d Cf. Vol. 4, pt. 1, p. 31, and Sects. 38 and 45 below.

^e CCIF, ch. 13, (pp. 152 ff.).

^f An account of a personal visit to this is in Blofeld (3), pp. 86 ff., 90-1. Cf. Fig. 1331.

^g See Anon. (115); Su Fēn, Chu Chia-Hsüan *et al.* (1). Similar report comes of Yüeh-Chhi,²⁴ d. Shatin, Hongkong, 1965 (priv. comm. Prof. Demiéville, whose files we have been privileged to consult).

¹ 聖賢

² 空海

³ 弘法大師

⁴ 眞身

⁵ 肉身

⁶ 辟穀

⁷ 絕穀

⁸ 木食行

⁹ 單道開

¹⁰ 茯苓

¹¹ 天台

¹² 智顗

¹³ 慧能

¹⁴ 禪

¹⁵ 南華寺

¹⁶ 曹溪

¹⁷ 光孝寺

¹⁸ 仁光

¹⁹ 普陀山

²⁰ 靜參

²¹ 慈航

²² 高野山

²³ 高僧傳

²⁴ 月溪

Could one, it may be asked, really end one's days in this way? It seems that after a long life, with the calm of old age, in the odour of sanctity (as the Taoists and Buddhists understood it), to the accompaniment of the chanting of sūtras from *Tao Tsang* or *Ta Tsang*, and surrounded by the wafting of incense, one could.^a Thereafter incorruptibility guaranteed either rebirth among the *hsien* as a holy immortal, or an entry into some Western paradise, striding along the way towards desired extinction. The relevance of all this for the pre-history of chemistry simply is that whether by arsenical elixir-poisoning or by self-mummification, the continued existence of the body was felt to justify in some measure the Taoist techniques, and that in turn encouraged all those adventures into the understanding of minerals and metals, and plant and animal drugs, which form the content of our history. If the elixirs could be verified by their immediate effects on the patient in the early stages, immortality could be justified at the last by incorruptibility.

With these words we had intended to conclude this volume, but during the past five years, and while it was in the writing, new archaeological discoveries were being made in China so relevant and so extraordinary that they must find mention here. In order to appreciate them let us take one last clear look at the idea of incorruptibility as proof of material immortality—what exactly did it mean?

At many places in our exposition there has been mention of the phrase *shih chieh*,¹ 'corpse-free', an epithet of the holy immortals.^b How this is understood within the living historic tradition can be seen from a catechism of the Taoist church circulating today. Li Shu-Huan writes:^c

Question no. 223. What is *shih chieh*?

Ans.: After the death of an adept seeking immortality (*hsiu hsien ché*), the form and skeleton remain behind while the immortal goes away; this is what is meant by *shih chieh*. When one is ready to rise up as an immortal, one leaves behind the malodorous house of clay, hence the expression 'corpse' (*shih*) from which the *hsien* is 'liberated' (*chieh hua*).^d

The *Chi Hsien Lu*⁵ says:^e 'When the appearance is like that of a living person—that is (proof of) *shih chieh*. When the feet have not turned bluish in colour, and the skin not

^a Old residents in Peking were familiar with two temples in the Western hills where mummies (*jou jen*,⁶ *jou shen*) were venerated. That at Thien-thai Ssu,⁸ near the cluster of eight famous sites (*Pa ta chhu*), was popularly supposed to be the mummy of the Shun-Chih emperor (r. +1644 to +1661) but not by scholars (cf. Fabre (1), p. 215; Arlington & Lewisohn (1), p. 304, with photograph; Anon. (100), p. 120; Lin Yü-Thang (7), map on p. 24). The lacquered mummy of a former monk or abbot was also to be seen, however, at one of the eight holy places, Pao-chu Tung¹⁰ (Precious Pearl Grotto: cf. Anon. (100), p. 119).

^b Cf. pp. 106-7, 284, 297-8.

^c (1), p. 164.

^d Lit. 'liberated and transformed (or transfigured)', a common expression for entering into immortality, as is *yü hua*,¹¹ lit. 'feathered (or winged) and transformed'. On this cf. Vol. 2, p. 141.

^e We cannot trace any book with this exact title. There is a *Chi Hsien Ching*¹² in TTS, but comparison of texts suggests that the quotation is most probably taken from some version of the *Chi Hsien Chuan*,¹³ written by Tsêng Tshao¹⁴ (fl. +1100 to +1147) in the Sung. Cf. SF, ch. 43, p. 23b. The text may well be earlier than him, however, if he simply re-wrote the work from the book of the same name which must have existed before the 7th century since it is listed in the *Sui Shu* bibliography.

¹ 尸解

² 修仙者

³ 尸

⁴ 解化

⁵ 集仙錄

⁶ 肉身

⁷ 肉身

⁸ 天台寺

⁹ 八大處

¹⁰ 寶珠洞

¹¹ 羽化

¹² 集仙經

¹³ 集仙傳

¹⁴ 曾慥

shrunk—that is (a sign of) *shih chieh*. When the light in the eyes has not gone dull, and looks like that of a person still alive—that again (shows) *shih chieh*. There are also those who have become alive once more after being dead; and some whose bodies have disappeared altogether before being encoffined; and others who have ascended, leaving only their hair behind^a—all these things are called *shih chieh*. Those who effect their liberation during the light of day become immortals of the higher category, while those who do so at night join the company of the lower.^b

All these (different phenomena) have to do with those who have obtained the Tao and gone away as immortals.^c

Thus inhibition of bodily decay was in all ages a pre-eminent mark of the attainment of material immortality.^d Presumably perfect preservation would keep the 'souls' together until the immortal was ready to arise into the heavens or begin his wanderings over the earth.^e So the body might be expected to disappear completely, either sooner or later.^f Tuan Chhêng-Shih,¹ writing about +850, tells a story (one only among others) of the excavation of a stone box filled with silk, out of which arose a grey-haired man of dignified mien who adjusted his clothing and disappeared.^g People said that this was a case of the *Thai Yin lien hsing fa*² of the Taoists.

What they meant was the liturgical or magical ceremonial designed to keep the *hun* and *pho* 'souls' together in an incorrupt body after death, defeating the baleful influences of the earth (*ti sha*³) and their spirits (*sha shen*⁴).^h The rites went by various names; sometimes 'nourishing the form' (*yang hsing Thai Yin fa*⁵),ⁱ or 're-moulding the form' (*Thai Yin lien hsing*⁶)^j by the aid of the Yin force at its fullness; sometimes

^a Effects of arsenic?

^b Presumably this reference is to *thien hsien*⁷ and *ti hsien*,⁸ cf. pp. 106ff. above.

^c One sometimes wonders whether a garbled version of these ideas could have been the origin of the corpus of vampire legends in Eastern Europe; cf. Calmet (1); Rycout (1); McCulloch (10). The word itself is of Turkish origin, so perhaps the Central Asian Turks misunderstood, and converted the benevolent immortals of China into the predatory Draculas of the Balkans. In Chinese literature there is very little on vampirism properly so called, and what there is is very late (cf. de Groot (2), vol. 5, pp. 723ff.).

^d Without multiplying examples we may mention that the body of Ku Huan,⁹ the editor of the Yang and Hsü texts of the Mao Shan *phai* (cf. p. 110 above) before Thao Hung-Ching, long remained uncorrupt (*Nan Chhi Shu*, ch. 54, p. 6a, b). So also did that of Hsü Hui¹⁰ himself (d. c. +370); cf. *Chen Kao*, ch. 20, p. 10a, b, mem. ch. 4, p. 15b. For the background see Strickmann (2), pp. 5, 33, (3), p. 35.

^e Could there also have been some unspoken connections with that Confucian commonplace of filial piety, keeping intact the body received from one's parents?

^f Or in certain cases it might be allowed to decompose if the 'souls' were held united by some substitute. Cf. p. 297 above.

^g *Yu-yang Tsa Tsu*,¹¹ Add. ch. 2, p. 4b. This is the second of three concerned with *chih no kao*,¹² i.e. Taoist ceremonies for summoning spirits.

^h Much further research is needed here, but in the meantime Mr Hou Chin-Lang has given us helpful information on which this paragraph is based.

ⁱ See *TT611*, ch. 4, pp. 14b-16b (late +9th cent. or early +10th). Cf. also Chi Yün's¹³ *Yueh Wei Tshao Thang Pi Chi*,¹⁴ c. 1800, Taipei ed. (p. 194).

^j Morohashi dict., vol. 3, p. 522.

¹ 段成式

² 太陰鍊形法

³ 地煞

⁴ 煞神

⁵ 養形太陰法

⁶ 太陰鍊形

⁷ 天仙

⁸ 地仙

⁹ 顧歡

¹⁰ 許翺

¹¹ 酉陽雜俎

¹² 支諾昂

¹³ 紀昀

¹⁴ 閱微草堂筆記

it was a matter of 'keeping life in the corpse by the five transformations' (*wu lien shêng shih chih fa*).^a But leaving prayers and spells let us turn to the techniques.

First there was the use of that beautiful and perdurable substance, jade. A few pages above (p. 284) we quoted Ko Hung on the preservative effects of small pieces, but we now know that if one could afford the expense, one could prepare complete body-cases of many jade scales wired together, inside which, one hoped and believed, the body would never decay. In 1968 two complete body-cases of this kind were found in princely tombs near Man-chhêng² in Hopei.^b One (Fig. 1332a) belonged to Liu Shêng,³ Prince Ching of Chung-shan,⁴ who died in -113,^c the other (Fig. 1332b) to his wife 'Tou Wan,⁵ probably the grand-niece of the Dowager Empress Tou.^d These 'jade clothes sewn with gold thread' (*chin lou yü i*)^e or jade cases (*yü hsia*)^f are composed of small rectangular plaques somewhat like those of scale armour,^g about 2,500 for the man and 2,160 for the woman,^h requiring some 1100 gms. of gold wire in the former case and 700 gms. in the latter.^g Further jade body-cases, partially complete, are coming to light in China.^h The Nanking Museum, for instance, has one sewn with silver wire which probably belonged to Liu Kung,⁸ Prince of Phêng-chhêng⁹ in the +2nd century.ⁱ Clearly the practice was not unusual in the Han period, though surely a forlorn hope for *shih chieh*. Could one believe that anything (other than mummification) ever really succeeded?

Before 1972 the answer would have been no, but an unprecedented finding then showed that the ancient Taoists knew how to achieve an almost perpetual conservation. A large tomb excavated at Ma-wang Tui¹⁰ near Chhangshaj proved to be that of a Lady of Tai¹¹,^k apparently the wife of the first Lord of that ilk (Li Tshang¹² or Li Chu-

^a See *TT* 1, ch. 3, p. 47b (perhaps late +5th cent., but not later than +7th); also *TT* 366 and *TT* 605. A liturgy called *lien tu*¹³ (salvation by transformation) still forms part of the *tso kung t'ê*¹⁴ funeral ceremonies surviving in Taiwan. Cf. Saso (1).

^b These body-cases have now been many times briefly described and figured—see Anon. (106), pls. 28, 29A; Hsia Nai, Ku Yen-Wên *et al.* (1), pp. 8-9, 13ff.; Wang Yeh-Chhiu *et al.* (1), pp. 38ff.; Anon. (115); Hsiao Wên (1); Bulling (14). A full description of the two tombs is given in Anon. (111), and a detailed account of the construction of the jade body-cases in Anon. (112).

^c Biography in *Shih Chi*, ch. 59, pp. 5b, 6a. An elder brother of Han Wu Ti, he was 'fond of wine and women' (like any good Taoist), but because of his rank probably to excess.

^d Han Ching Ti's mother.

^e They fit end on, however, without overlapping, and naturally triangular and other shapes are necessary at some places.

^f There were also the seven customary pieces of jade for the seven orifices of each body, and symbolic pieces were placed in the hands.

^g Another comment, in itself, on what we have said about gold above (pp. 47ff.).

^h They also explain the purpose of many isolated plaques, hitherto puzzling, in great collections such as that of the Royal Ontario Museum at Toronto.

ⁱ A son of Han Ming Ti, his tomb near Hsüchow north of Huai-an was excavated in 1970.

^j We first heard of the discovery in Peking from scholarly friends on 20 July; the first public pronouncement was made on 31 July, and the official report, Anon. (104), appeared early in August. This was soon followed by many more popular versions in Japanese and Western languages as well as Chinese—Anon. (105); Anon. (113, 114); Miyagawa Torao *et al.* (1).

^k Tai Hou chhi tzu¹⁵.

¹ 五煉生尸之法

² 滿城

³ 劉勝

⁴ 中山靖王

⁵ 竇綰

⁶ 金縷玉衣

⁷ 玉匣

⁸ 劉恭

⁹ 彭城王

¹⁰ 馬王堆

¹¹ 獻

¹² 利倉

¹³ 煉度

¹⁴ 做功德

¹⁵ 獻侯妻子

Tshang¹), enfeoffed in -193.^a She would have died about -186,^b and the painted outer coffins were filled with a great variety of rich and beautiful objects,^c then sealed tightly with layers of charcoal and a kind of sticky white clay (cf. Fig. 1333). So far nothing unique, but when the body was finally uncovered it was found to be like that of a person who had died only a week or two before (Fig. 1334).^d The elasticity of the subcutaneous tissues was conserved in an extraordinary way, for when the skin was pressed it at once returned to normal when the pressure was released. Similarly, preservative solutions when injected raised swellings which after a short time subsided. The body was partly immersed in a brownish aqueous liquid, which contained mercuric sulphide, the atmosphere in the coffins was largely methane under some pressure, the temperature had been constant at about 13°C., and the coffin complex had been air-tight and water-tight.

The interest of the discovery lies in the fact that it suggests for the first time all that *shih chieh* may have implied, and how much chemical knowledge and skill the ancient Taoists may have commanded.^e For the perfect preservation was not achieved by embalming,^f nor any kind of mummification,^g nor yet by tanning,^h nor by freezing. However it was done it shows that the incorruptibility stories of the Taoists were not all myth, and it adds another dimension to their doctrine of material immortality, so strange to modern minds yet so fertile historically in generating chemo-therapy through all the cultures of the world.

^a He was a son of Han Hui Ti.

^b I.e. the date of his own death. Though she could perhaps have been the wife of one of three of his successors, the latest possible date for her decease is -141.

^c E.g. remarkable figured textiles and painted silks, musical instruments, lacquer utensils, pottery, foods, and a host of wooden serving-maids to look after her in the next world. Also bags and pouches of medicinal and aromatic plant materials.

^d The colour of the femoral artery, for instance, was like that of the newly dead. The fingers and toes were quite unshrivelled. The Lady of Tai was about 50 years of age; she had at some time broken a rib, and calcified tubercular nodules were evident in the lungs. Histological work on all the tissues is now proceeding. A picture of the body under study in the laboratory of the Hunan Medical College is given by Miyagawa *et al.* (1), pp. 60-1.

^e Consultation with friends expert in forensic medicine such as Professor James Cameron and Dr Bernard Sims at the London Hospital has confirmed the uniqueness of the find. Now that one such case is known, we may expect further researches to discover more. Indeed, Yang Po-Chün (1) has found descriptions of five similar examples in the literature (*Shui Ching Chu*, *Chin Shu*, etc.) before +650.

^f Using e.g. formalin, alcohol and other organic chemicals only known in relatively modern times; cf. Polson, Brittain & Marshall (1). Mercury is not permissible today because of possible toxicological investigations. Chlorinated water will also preserve remarkably, but chlorine was not known in antiquity.

^g Desiccation by natron, with addition of resins and aromatics; cf. p. 75 above.

^h As in the Danish bog burials where the tissues were acid-tanned by the peat-water; cf. Glob (1).

¹ 黎朱倉



Fig. 1311. Taoist sage holding a magic mushroom (*chih*); a painting by Chhen Hung-Shou (+1599 to +1652). Photo. Wasson (3), pl. xx.

For Fig. 1309 see Pl. CDXLIII overleaf.



Fig. 1309. The celestial bureaucracy of Taoism, a popular syncretistic version headed by Lao Tzu, Buddha and Confucius (from Doré (1), vol. 6, fig. 2). To the left, the seven officials of the stars of the Great Bear (the Northern Dipper, *Pei Tou*); to the right, the six officials of the Southern Dipper (Nan Tou, *hsiu* no. 8, det. ϕ -Sagittarii).

In the second row down, the god of literature (*Wên Chhang*), the god of the Eastern Sacred Mountain (*Thai Shan, Tung Yo*), and the goddess of lightning (*Tien Mu*) are seen on the left; the thunder-god (*Lei Kung*) and the Lord of Drugs (*Yao Wang*), among others, on the right. *Kuan-Yin*, Goddess of Mercy, sits serenely at the centre, her dragon-maid attending upon her with the vase of the Water of Life (*amṛta*) and the willow-branch for aspersing it.

The third row includes some of the Directors of the (Five) Elements, as also the god of longevity (*Shou Hsing*). One also sees, on the left, the High Mistress of Abundant Rainfall (*Shui Man Niang-niang*), the city-god of the capital (*Tu Chhêng Huang*), and next him, raised to this exalted level, the alchemical adept *Lü Shun-Yang* (*Lü Tung-Pin*), patron saint, perhaps, of chemical and physiological processes.

In the fourth row the Protector of Goods in Transit (*Wu Lu Tshai Shen*) and the Director-General of Fire (*Huo Shen*) appear on the left; the Minister of Telecommunications (*Chhien Li Yen*) among those present on the right.

The bottom row depicts some of the Comptrollers of Diseases in man and the domestic animals, as also the Mistress of Fertility (*Sung Tzu Niang-niang*) who grants children or withholds them. That spirit so prominent in the history of alchemy, *Tsao Chün*, god of the stove, can be observed second from the left in the lowest row.

It will be noticed that some of these celestial officials seem to be sitting on wheeled chairs. Such wheels were but a symbol of their capacity to appear and act instantaneously anywhere, 'reaching', like Wisdom, 'from one end of the world to the other mightily'.



Fig. 1312. Jade girl bearing a magic mushroom plant (*ling chih*) growing in a pot, among an assembly of the immortals. Fresco from the Yung-Lo Kung, a Taoist temple of Sung and Yuan times in southern Shansi. Photo. Têng Pai (1).



Fig. 1314. Cast-iron incense-burner in a Taoist temple at Yünkang (near Ta-tung in Shansi) with a dated inscription of +1785 (orig. photo., 1964).



Fig. 1315. Clouds of incense from fragrant logs burning in the courtyard of a Taoist temple as part of a funeral or memorial liturgy; altars with food-offerings in the background. Photo. H. von Perckhammer, from Boerschmann (11), 1931.

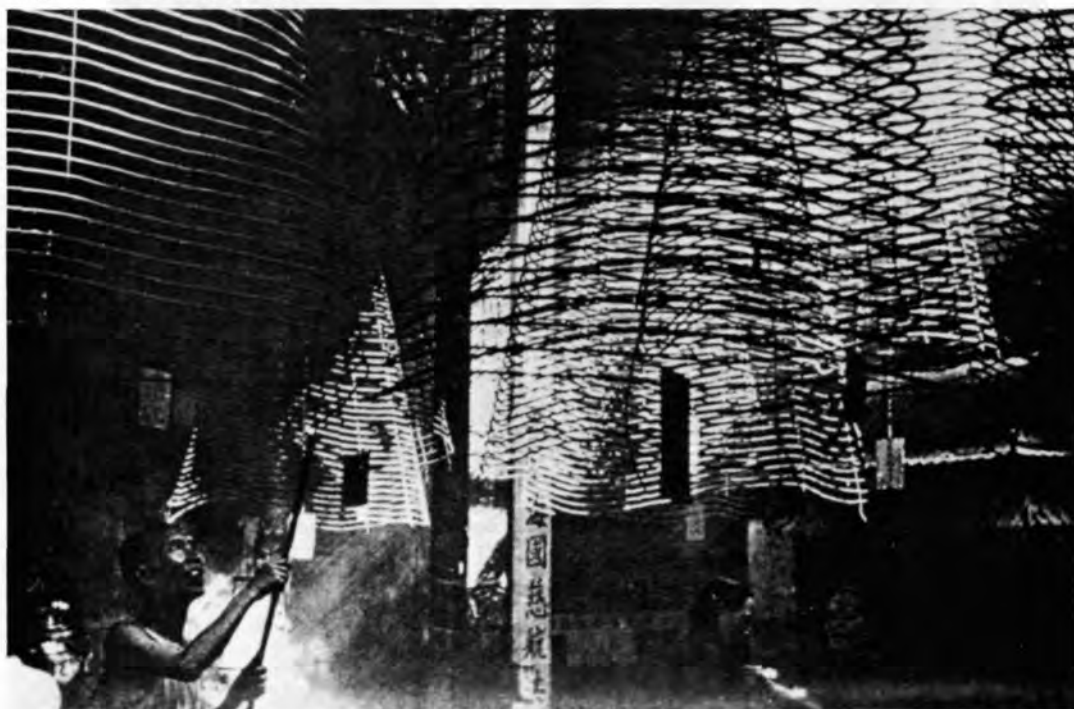


Fig. 1316. Coils of slow-burning incense in a Cantonese temple (photo. Norman Lewis, 1951).



Fig. 1317. Typical long-handled censer of Thang and Sung times, from a Tunhuang fresco of Hsi-Hsia date (+ 11th or + 12th century). Cave no. 409, copy-painting by Tuan Wên-Chieh, reproduced in Anon. (10), pl. 68B.



Fig. 1320. A scene of Buddhist ordination at Chhêngtu, Szechuan, in 1945. The nine brands caused by the incense-cones a few days previously, permanent stigmata, can be seen on the head of the new monk looking downwards on the right. Photo. Sanders.



Fig. 1322. Lead vessels high in antimony, from the Shang or early Chou periods (photo. Rijksmuseum, Amsterdam).



Fig. 1320. Traditional representation of Wei Po-Yang, his disciple Yü shēng, and the dog on which they tested the elixir (*Lieh Hsien Chhūan Chuan*, ch. 3, p. 12*b*). See p. 295.

For Figs. 1323-5 and 1327 see Pl. CDL overleaf.

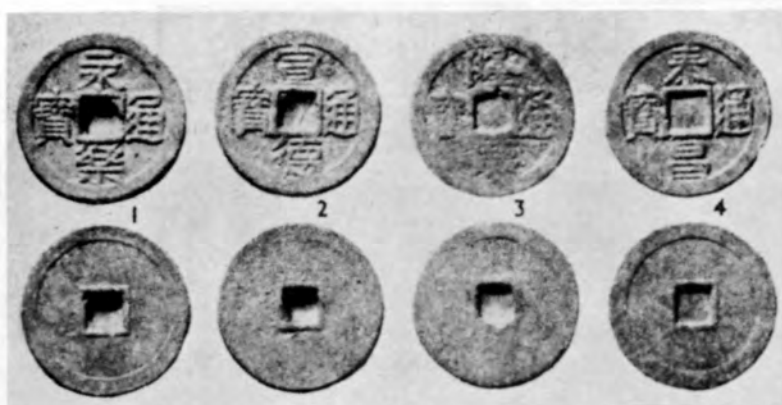


Fig. 1323



Fig. 1324



2



Fig. 1325

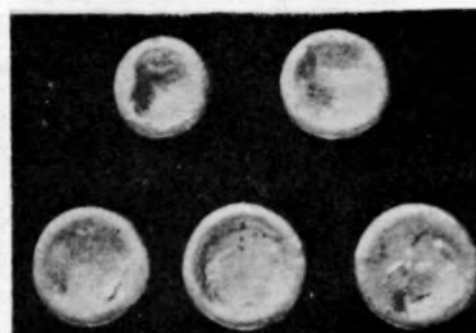


Fig. 1327

PLATE CDL

Fig. 1323. Zinc coins of the Ming period (from Leeds, 1). 1. Yüing-Lo r.p., 99 % Zn. 2. Hsüan-Tê r.p., 98 % Zn. 3. Lung-Ching r.p., 98.7 % Zn. 4. Thai-Chhang r.p., 97.6 % Zn.

Fig. 1324. Paktong coins (cupro-nickel) from early periods (from Sung Ta-Jen, p.c.). 1. Ta Hsia dynasty, Chen-Hsing r.p. (+419 to +425), a rubbing. 2. Sui dynasty, *wu chu* coin (c. +610), rubbing and photo.

Fig. 1325. Cupro-nickel coins from Greek Bactria (Tarn, 1). 5. Euthydemus II. 8. Pantaleon. 9. Agathocles.

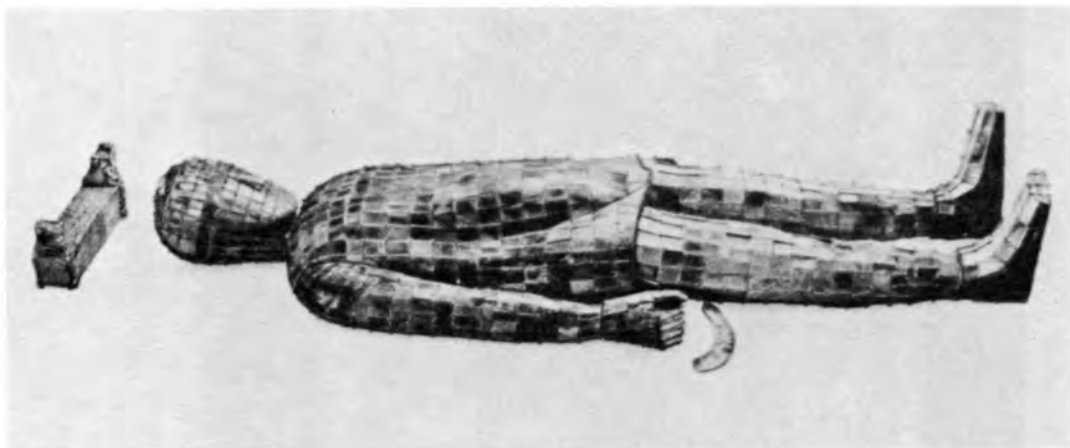
Fig. 1327. Pieces of 'unicorn-foot horse-hoof gold' (*lin chih ma thi chin*) recovered from an Early Han tomb (cf. pp. 257 ff.); above, obverse; below, reverse. From Chieh Hsi-Kung (1), pls., p. 11, figs. 22, 23. Many similar pieces, like buttons with a concave side, were found in the tomb of Liu Shêng (d. -113) at Man-chhêng, on which see p. 303. The earliest ones known derive from a Warring States tomb in Anhui. Recently, larger hoof-shaped castings of gold (*chin ping*), about 250 gms. in weight, corresponding to the Han catty (*chin*), have been found in tombs of this period at Hsienyang in Shensi (Anon. 116) and elsewhere. The smaller pieces average a sixteenth of this weight, about 15.6 gms., corresponding to the Han ounce (*liang*); cf. An Chih-Min (2), who sees a connection with the stamped gold coins of the State of Chhu (cf. p. 49 above).



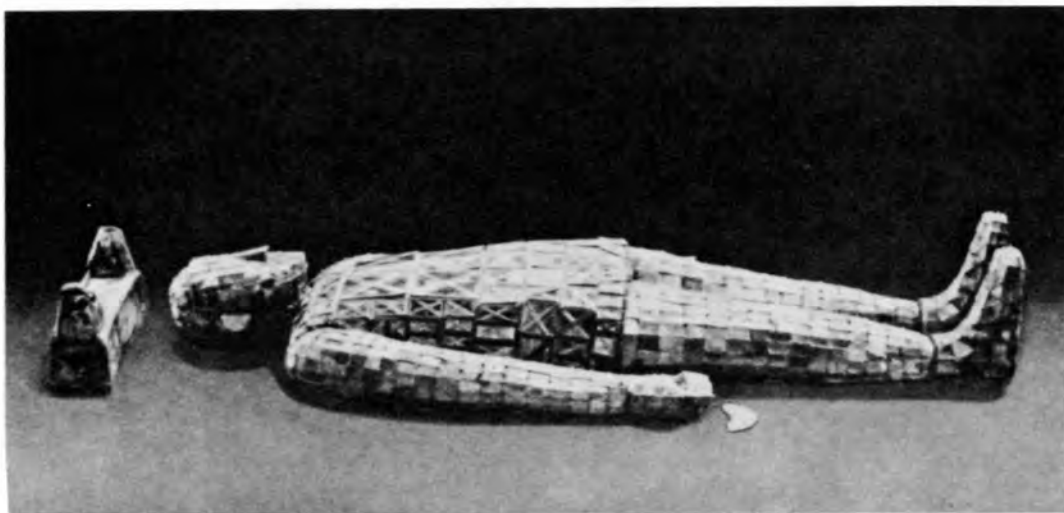
Fig. 1330. The self-mummified effigy of the 6th Chhan Buddhist patriarch Hui-Neng, dating from + 713 and still preserved in the Nan-Hua Ssu temple at T'shao-chhi near Chhü-chiang in Kuangtung. Lo Hsiang-Lin (3), pl. 4.



Fig. 1331. Bronze statue of Hui-Neng in the Liu-Jung Ssu (Six Banyan Temple) at Canton (photo. J. D. Bernal). Local tradition ascribes it to + 989, but an early Chhing date is much more probable (cf. Lo Hsiang-Lin (3), pl. 8). For us today the statue is more revealing of the man, however, than the self-mummified remains in Fig. 1330.



(a)



(b)

Fig. 1332. Jade body-cases from the tombs of the princely house of Chung-shan, near Man-chhêng in Hopei, excavated in 1968. These 'jade clothes sewn with golden thread' (*chün lou yü i*) were believed to ensure the incorruptibility of the corpse, so that the spirit of the adept or patrician could rest in it until ready to join the ranks of the holy immortals in the cloudy or stellar heavens as a *thien hsien*. But such apparatus could only be afforded by people of some wealth.

(a) The *yü i* of Liu Shêng, Prince of Chung-shan (d. — 113). Photo. Anon. (106), pl. 28.

(b) The *yü i* of his consort, Tou Wan. Photo. Anon. (106), pl. 29A.



Fig. 1333. The body of the Lady of Tai (d. *c.* — 166), wrapped in more than twenty silk garments, as at first uncovered (photo. Academia Sinica). The mouth is filled with the protective amulet of jade.

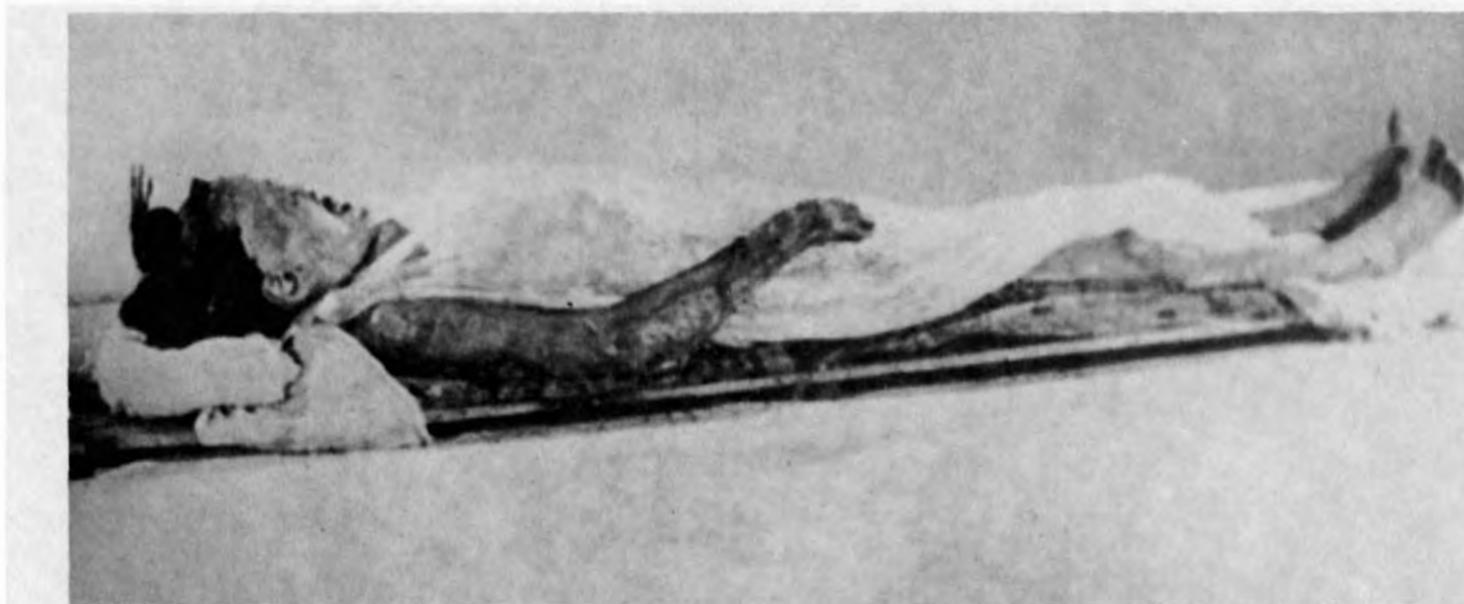


Fig. 1334. The body of the Lady of Tai as studied in the laboratory. Although she had been dead for more than two thousand years, a relatively perfect preservation had been achieved, yet neither by embalming, mummification nor tanning.

This exemplifies, perhaps, the *shih chieh* of the ancient Taoists, and gives some indication of their practical chemical knowledge. Photo. NCNA, Hongkong, by the kindness of Li Tsung-Ying; a still from the Academia Sinica film.



Fig. 1335. Silver boxes containing labelled chemicals (materia medica) from a hoard found at Hsing-hua Fang within the T'ang city of Ch'ang-an (now Ho-chia-tshun village just south-west of modern Sian), and excavated in 1970 (see p. 161 above). They belonged to the family of Li Shou-Li, Prince of Pin (a cousin of the emperor Thang Hsüan Tsung) who died in +741, and were probably buried in +756 when his son was fleeing from the rebel army of An Lu-Shan. Photo. Academia Sinica; cf. Anon. (106), pls. 65B, 66A (left).

Here left, the inscription reads: 'Stalactitic calcite (*ju*), best quality, 16 oz.' Centre, it says: 'Amber (*hu pho*), 10 lumps; best second-grade cinnabar (*kuang ming sha*), 21 oz.; total weight, 36 oz.' Right, at back, silver pan of transparent quartz (*pai shih ying*); in front, purplish amethystine quartz (*tzu shih ying*); cf. Anon. (106), pls. 66C, D. Besides the chemicals shown here, there were also, for example, supplies of litharge (*mi-tho-sêng*), coral (*shan hu*), gold powder (*chin mien*) and gold leaf (*chin po*). This was the hoard which also contained pieces of apparatus probably alchemical (cf. Vol. 5, pt. 4).



Fig. 1336. Hill-censer (*po shan hsiang lu*, cf. Vol. 3, p. 581) from the tomb of Liu Shêng (-113) at Man-chhêng (cf. p. 303 and the caption to Fig. 1332). Made of bronze inlaid with gold, it represents the magic isle of the immortals, Phêng-lai (cf. Vol. 2, pp. 240-1) rising above the waves of the Eastern Ocean, and in its crevices are depicted tigers, wild boars and monkeys as well as human beings. The base is surrounded by a coiled dragon. Ht. 26 cm, diam. 9.7 cm. Photo. NCNA, Hongkong; for colour plates see Anon. (106), pl. 5; Hsiao Wên (1), p. 25; Hsia Nai *et al.* (1), pl. 6; Anon. (115), pl. 3.



Fig. 1337. Early Han tomb-model of painted pottery (— 1st or — 2nd century) from Wu-ying Shan near Chinan in Shantung, recovered in 1969; cf. Anon. (113). Photo. Academia Sinica; cf. Anon. (106), pl. 126. The magic dove (*chiu*), or perhaps a *phêng* bird (cf. Vol. 2, p. 81), about to ascend into the realm of the immortals, carries on its back two alchemists, who are greeting each other, with their *ting* elixir vessels behind them, while an attendant wearing the same curious headdress and standing more towards the tail, holds an umbrella over them. Ht. 40.5 cm, breadth 45 cm. Cf. pp. 104 ff., 113 and 124 ff.



Fig. 1338. Another painted pottery model on the same theme from the same tomb. Photo. Academia Sinica; cf. Anon. (106), pl. 127A. By comparison with the preceding, this is a freight flight, for the *chiu* or *phêng* carries only two large *hu* pots, doubtless filled with elixirs. Ht. 52.5 cm, breadth 46 cm.

(a)



(b)

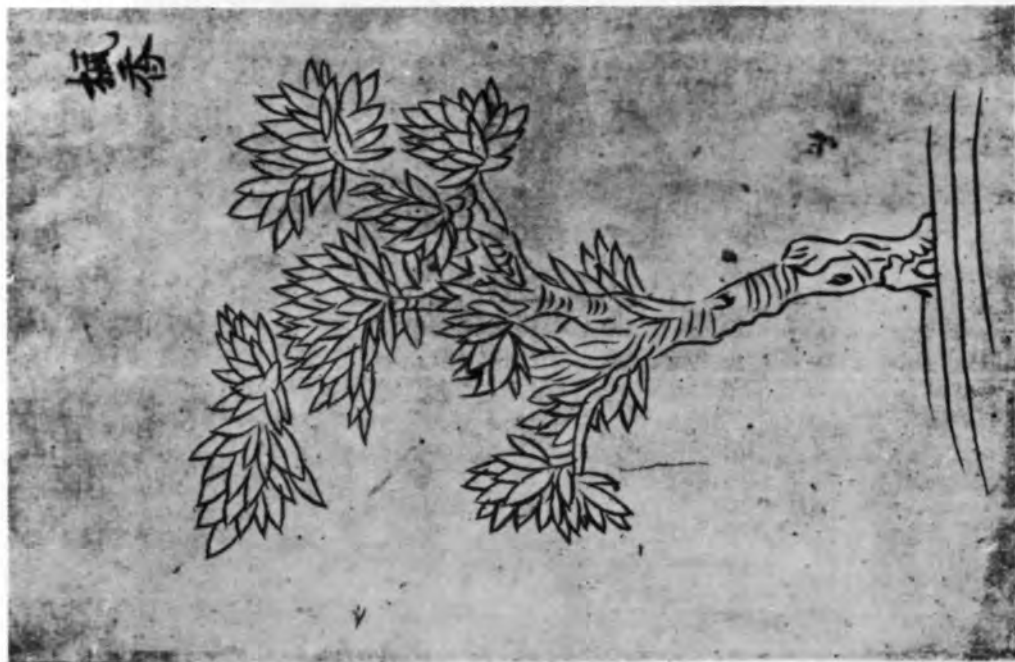


Fig. 1330. Drawings from the *Hsiang Yao Chhiao* (Memoir on Aromatic Plants and Incense) by Kuan-Yu (Kanyu), c. + 1163, a MS. preserved in Japan. Many of them closely resemble in style those of the *Shao-Hsing Pên Tshao* of + 1159 (e.g. chs. 10B, 13B, etc.), though often rather better. Cf. Karow (2). In the finding of these at the Royal Ontario Museum, Toronto, thanks are due to Dr Shih Hsiieh-Yen.

(a) The tree *Aquilaria agallocha* or *sinensis*, the diseased wood of which gives *chhen hsiang*, lignaloes or garroo (Burkill (1), vol. 1, pp. 197 ff.; Anon. (109), vol. 2, p. 948.1; cf. Dioscorides, *De Mat. Med.* 1, 21). Provenance Cantonese. See p. 141.

(b) The tree *Liquidambar formosana* (= *taicaniensis*; Anon. (109), vol. 2, p. 159.1), yielding *fêng hsiang*, liquid storax or rose malloes. Kuan-Yu's hint of the hastate leaves is noteworthy. See p. 142.

(a)



(b)



Fig. 1340. Drawings from the *Hsiang Yao Chiao* (c. + 1163).

(a) *Yü chin hsiang*, wild turmeric species, *Curcuma aromatica*, *zedoaria* or *longa*, which yield essential oils smelling like ginger and camphor (R 646a; CC 1763-4; Burkill (1), vol. 1, pp. 704 ff.). Note the long oblanceolate leaves.

(b) *Pai tou khau*, a Cantonese cardamom, *Anomum cardamomum*, *xanthoides* or *echino:phaera*, yielding complex and very aromatic essential oils (R 641; CC 1761; Burkill (1), vol. 1, pp. 131 ff.; Dioscorides, *De Mat. Med.* 1, 5).

(a)



(b)



PLATE CDLXI

Fig. 1341. Drawings from the *Hsiang Yao Chhao* (c. + 1163).

(a) The *chhing mu hsiang* from Haichow, an excellent drawing of *Aristolochia debilis*, perhaps from a variety of which the leaves were more truncate than cordate (Anon. (109), vol. 1, p. 547. 1). This is an ancient medicinal plant but not well known as an aromatic, so perhaps Kuan-Yu had intended to draw other *mu hsiang* plants such as *Aucklandia Costus*, *Saussurea lappa* or *Inula racemosa*, which give the fragrant costus or putchuk roots (cf. p. 141).

(b) The *mao hsiang* from Liuchow, an excellent drawing of one of the perfume-bearing monocotyledon species, either citronella grass, *Cymbopogon* (= *Andropogon*) *Nardus*, or vanilla grass, *Hierochloa borealis* (cf. p. 136 and p. 140).

Some of these woodcut drawings, with their simplicity and beauty of line, recall the illustrations given by the German fathers of botany, four hundred years later (see Sect. 28 in Vol. 6).

BIBLIOGRAPHIES

- A CHINESE AND JAPANESE BOOKS BEFORE +1800
- B CHINESE AND JAPANESE BOOKS AND JOURNAL ARTICLES SINCE +1800
- C BOOKS AND JOURNAL ARTICLES IN WESTERN LANGUAGES

In Bibliographies A and B there are two modifications of the Roman alphabetical sequence: transliterated *Chh-* comes after all other entries under *Ch-*, and transliterated *Hs-* comes after all other entries under *H-*. Thus *Chhen* comes after *Chung* and *Hsi* comes after *Huai*. This system applies only to the first words of the titles. Moreover, where *Chh-* and *Hs-* occur in words used in Bibliography C, i.e. in a Western language context, the normal sequence of the Roman alphabet is observed.

When obsolete or unusual romanisations of Chinese words occur in entries in Bibliography C, they are followed, wherever possible, by the romanisations adopted as standard in the present work. If inserted in the title, these are enclosed in square brackets; if they follow it, in round brackets. When Chinese words or phrases occur romanised according to the Wade-Giles system or related systems, they are assimilated to the system here adopted (cf. Vol. 1, p. 26) without indication of any change. Additional notes are added in round brackets. The reference numbers do not necessarily begin with (1), nor are they necessarily consecutive, because only those references required for this volume of the series are given.

Korean and Vietnamese books and papers are included in Bibliographies A and B. As explained in Vol. 1, pp. 21 ff., reference numbers in italics imply that the work is in one or other of the East Asian languages.

ABBREVIATIONS

See also p. xiv

<i>A</i>	<i>Archeion</i>	<i>AJA</i>	<i>American Journ. Archaeology</i>
<i>AA</i>	<i>Artibus Asiae</i>	<i>AJOP</i>	<i>Amer. Journ. Physiol.</i>
<i>AAA</i>	<i>Archaeologia</i>	<i>AJPA</i>	<i>Amer. Journ. Physical Anthro-</i> <i>pology</i>
<i>AAAA</i>	<i>Archaeology</i>	<i>AJSC</i>	<i>American Journ. Science and Arts</i> <i>(Silliman's)</i>
<i>A/AIHS</i>	<i>Archives Internationales d'Histoire</i> <i>des Sciences (continuation of</i> <i>Archeion)</i>	<i>AM</i>	<i>Asia Major</i>
<i>AAN</i>	<i>American Anthropologist</i>	<i>AMA</i>	<i>American Antiquity</i>
<i>AAPWM</i>	<i>Archiv. f. Anat., Physiol., and</i> <i>Wiss. Med. (Joh. Müller's)</i>	<i>AMH</i>	<i>Annals of Medical History</i>
<i>ABAW/PH</i>	<i>Abhandlungen d. bayr. Akad. Wiss.</i> <i>München (Phil.-Hist. Klasse)</i>	<i>AMS</i>	<i>American Scholar</i>
<i>ACASA</i>	<i>Archives of the Chinese Art Soc. of</i> <i>America</i>	<i>AMY</i>	<i>Archaeometry (Oxford)</i>
<i>ACF</i>	<i>Annuaire du Collège de France</i>	<i>AN</i>	<i>Anthropos</i>
<i>ADVC</i>	<i>Advances in Chemistry</i>	<i>ANATS</i>	<i>Anatolian Studies (British School</i> <i>of Archaeol. Ankara)</i>
<i>ADVS</i>	<i>Advancement of Science (British</i> <i>Assoc., London)</i>	<i>ANS</i>	<i>Annals of Science</i>
<i>AEM</i>	<i>Anuario de Estudios Medievales</i> <i>(Barcelona)</i>	<i>ANT</i>	<i>Antaios (Stuttgart)</i>
<i>AEPHE/SHP</i>	<i>Annuaire de l'Ecole Pratique des</i> <i>Hautes Études (Sect. Sci. Hist.</i> <i>et Philol.)</i>	<i>ANTJ</i>	<i>Antiquaries Journal</i>
<i>AEPHE/SSR</i>	<i>Annuaire de l'Ecole Pratique des</i> <i>Hautes Études (Sect. des Sci.</i> <i>Religieuses)</i>	<i>AP</i>	<i>Aryan Path.</i>
<i>AESC</i>	<i>Aesculape (Paris)</i>	<i>APH</i>	<i>Actualités Pharmacologiques</i>
<i>AEST</i>	<i>Annales de l'Est (Fac. des Lettres,</i> <i>Univ. Nancy)</i>	<i>AP/HJ</i>	<i>Historical Journal, National Pei-</i> <i>ping Academy</i>
<i>AF</i>	<i>Ärztliche Forschung</i>	<i>APAW/PH</i>	<i>Abhandlungen d. preuss. Akad.</i> <i>Wiss. Berlin (Phil.-Hist. Klasse)</i>
<i>AFG</i>	<i>Archiv. f. Gynäkologie</i>	<i>APHL</i>	<i>Acta Pharmaceutica Helvetica</i>
<i>AFGR/CINO</i>	<i>Atti della Fondazione Giorgio</i> <i>Ronchi e Contributi dell'Istituto</i> <i>Nazionale di Ottica (Arcetri)</i>	<i>APNP</i>	<i>Archives de Physiol. normale et</i> <i>pathologique</i>
<i>AFP</i>	<i>Archivum Fratrum Praedicatorum</i>	<i>AQ</i>	<i>Antiquity</i>
<i>AFRA</i>	<i>Afrasian (student Journal of</i> <i>London Inst. Oriental & Afri-</i> <i>can Studies)</i>	<i>AR</i>	<i>Archiv. f. Religionswissenschaft</i>
<i>AGMN</i>	<i>Archiv. f. d. Gesch. d. Medizin</i> <i>u. d. Naturwissenschaften (Sud-</i> <i>hoff's)</i>	<i>ARB</i>	<i>Annual Review of Biochemistry</i>
<i>AGMW</i>	<i>Abhandlungen z. Geschichte d.</i> <i>Math. Wissenschaft</i>	<i>ARLC/DO</i>	<i>Annual Reports of the Librarian of</i> <i>Congress (Division of Orientalia)</i>
<i>AGNT</i>	<i>Archiv. f. d. Gesch. d. Naturwiss.</i> <i>u. d. Technik (cont. as</i> <i>AGMNT)</i>	<i>ARMC</i>	<i>Ann. Reports in Medicinal Chem-</i> <i>istry</i>
<i>AGP</i>	<i>Archiv. f. d. Gesch. d. Philosophie</i>	<i>ARO</i>	<i>Archiv Orientalni (Prague)</i>
<i>AGR</i>	<i>Asahigraph</i>	<i>ARQ</i>	<i>Art Quarterly</i>
<i>AGWG/PH</i>	<i>Abhdl. d. Gesell. d. Wiss. Z.</i> <i>Göttingen (Phil.-Hist. Kl.)</i>	<i>ARSI</i>	<i>Annual Reports of the Smithsonian</i> <i>Institution (Washington, D.C.)</i>
<i>AHES/AHS</i>	<i>Annales d'Hist. Sociale</i>	<i>AS/BIHP</i>	<i>Bulletin of the Institute of History</i> <i>and Philology, Academia Sinica</i>
<i>AHOR</i>	<i>Antiquarian Horology</i>	<i>AS/CJA</i>	<i>Chinese Journal of Archaeology,</i> <i>Academia Sinica</i>
<i>AIENZ</i>	<i>Advances in Enzymology</i>	<i>ASEA</i>	<i>Asiatische Studien; Études Asia-</i> <i>tiques</i>
<i>AIP</i>	<i>Archives Internationales de Physio-</i> <i>logie</i>	<i>ASN/Z</i>	<i>Annales des Sciences Naturelles;</i> <i>Zoologie (Paris)</i>
		<i>ASSF</i>	<i>Acta Societatis Scientiarum Fen-</i> <i>nicæ (Helsingfors)</i>
		<i>AT</i>	<i>Atlantis</i>
		<i>ATOM</i>	<i>Atomes (Paris)</i>
		<i>AX</i>	<i>Ambix</i>
		<i>BABEL</i>	<i>Babel; Revue Internationale de la</i> <i>Traduction</i>
		<i>BCGS</i>	<i>Bull. Chinese Geological Soc.</i>
		<i>BCP</i>	<i>Bulletin Catholique de Pékin</i>

BCS	<i>Bulletin of Chinese Studies</i> (Chhêngtu)	CEM	<i>Chinese Economic Monthly</i> (Shanghai)
BDCG	<i>Ber. d. deutsch. chem. Gesellschaft.</i>	CEN	<i>Centaurus</i>
BE/AMG	<i>Bibliographie d'Études (Annales du Musée Guimet)</i>	CHEMC	<i>Chemistry in Canada</i>
BEC	<i>Bulletin de l'École des Chartes</i> (Paris)	CHI	<i>Cambridge History of India</i>
BEFED	<i>Bulletin de l'École Française de l'Extrême Orient</i> (Hanoi)	CHIM	<i>Chimica</i> (Italy)
BGSC	<i>Bulletin of the Chinese Geological Survey</i>	CHIND	<i>Chemistry and Industry</i> (Journ. Soc. Chem. Ind. London)
BGTI	<i>Beiträge z. Gesch. d. Technik u. Industrie</i> (continued as <i>Technik Geschichte</i> —see BGTI/TG)	CHJ	<i>Chhing-Hua Hsüeh Pao</i> (Chhing-Hua (Ts'ing-Hua) University Journal of Chinese Studies)
BGTI/TG	<i>Technik Geschichte</i>	CHJ/T	<i>Chhing-Hua (Ts'ing-Hua) Journal of Chinese Studies</i> (New Series, publ. Taiwan)
BHMZ	<i>Berg und Hüttenmännische Zeitung</i>	CHWSLT	<i>Chung-Hua Wên-Shih Lun Tshung</i> (Collected Studies in the History of Chinese Literature)
BIHM	<i>Bulletin of the (Johns Hopkins) Institute of the History of Medicine</i> (cont. as <i>Bulletin of the History of Medicine</i>)	CHYM	<i>Chymia</i>
Bj	<i>Biochemical Journal</i>	CHZ	<i>Chemiker Zeitung</i>
BjRL	<i>Bull. John Rylands Library</i> (Manchester)	CIBA/M	<i>Ciba Review</i> (Medical History)
BK	<i>Bunka</i> (Culture), Sendai	CIBA/MZ	<i>Ciba Zeitschrift</i> (Medical History)
BLSOAS	<i>Bulletin of the London School of Oriental and African Studies</i>	CIBA/S	<i>Ciba Symposia</i>
BM	<i>Bibliotheca Mathematica</i>	CIBA/T	<i>Ciba Review</i> (Textile Technology)
BMFEA	<i>Bulletin of the Museum of Far Eastern Antiquities</i> (Stockholm)	CIMC/MR	<i>Chinese Imperial Maritime Customs</i> (Medical Report Series)
BMFj	<i>Bulletin de la Maison Franco-Japonaise</i> (Tokyo)	CIT	<i>Chemie Ingenieur Technik</i>
BMj	<i>British Medical Journal</i>	Cj	<i>China Journal of Science and Arts</i>
BNj	<i>British Numismatic Journ.</i>	CjFC	<i>Chin Jih Fo Chiao</i> (Buddhism Today), Taiwan
BOE	<i>Boethius; Texte und Abhandlungen d. exakte Naturwissenschaften</i> (Frankfurt)	CLINR	<i>Clinical Radiology</i>
BR	<i>Biological Reviews</i>	CLR	<i>Classical Review</i>
BS	<i>Behavioural Science</i>	CMj	<i>Chinese Medical Journal</i>
BSAA	<i>Bull. Soc. Archéologique d'Alexandrie</i>	CN	<i>Chemical News</i>
BSAB	<i>Bull. Soc. d'Anthropologie de Bruxelles</i>	CNRS	<i>Centre National de la Recherche Scientifique</i>
BSCF	<i>Bull. de la Société Chimique de France</i>	COCj	<i>Coin Collectors' Journal</i>
BSGF	<i>Bull. de la Société Géologique de France</i>	COPS	<i>Confines of Psychiatry</i>
BSjR	<i>Bureau of Standards Journ. of Research</i>	CP	<i>Classical Philology</i>
BSPB	<i>Bull. Soc. Pharm. Bordeaux</i>	CQ	<i>Classical Quarterly</i>
BUA	<i>Bulletin de l'Université de l'Aurore</i> (Shanghai)	CR	<i>China Review</i> (Hongkong and Shanghai)
BV	<i>Bharatiya Vidya</i> (Bombay)	CRAS	<i>Comptes Rendus hebdomadaires de l'Acad. des Sciences</i> (Paris)
CA	<i>Chemical Abstracts</i>	CREC	<i>China Reconstructs</i>
CALM	<i>California Medicine</i>	CRESC	<i>Crescent</i> (Surat)
CBH	<i>Chügoku Bungaku-hö</i> (Journ. Chinese Literature)	CRR	<i>Chinese Recorder</i>
CCj	<i>Chung-Chi Journal</i> (Chhung-Chi Univ. Coll. Hongkong)	CRRR	<i>Chinese Repository</i>
CDA	<i>Chinesisch-Deutschen Almanach</i> (Frankfort a/M)	CS	<i>Current Science</i>
		CUNOB	<i>Cunobelin; Yearbook of the British Association of Numismatic Societies</i>
		CUP	<i>Cambridge University Press</i>
		CUQ	<i>Columbia University Quarterly</i>
		CURRA	<i>Current Anthropology</i>
		CVS	<i>Christiana Videnskabselskabet Skifter</i>
		CW	<i>Chemische Weekblad</i>
		CWR	<i>China Weekly Review</i>
		DAZ	<i>Deutscher Apotheke Zeitung</i>
		DB	<i>The Double Bond</i>

DI	<i>Der Islam</i>	HHS	<i>Hua Hsüeh (Chemistry), Ch. Chem. Soc.</i>
DK	<i>Dōkyō Kenkyū (Researches in the Taoist Religion)</i>	HHSTH	<i>Hua Hsüeh Thung Hsün (Chemical Correspondent), Chekiang Univ.</i>
DMAB	<i>Abhandlungen u. Berichte d. Deutsches Museum (München)</i>	HITC	<i>Hsüeh I Tsa Chih (Wissen und Wissenschaft), Shanghai</i>
DS	<i>Desalination (International Journ. Water Desalting) (Amsterdam and Jerusalem, Israel)</i>	HJAS	<i>Harvard Journal of Asiatic Studies</i>
DV	<i>Deutsche Vierteljahrschrift</i>	HMSO	<i>Her Majesty's Stationery Office</i>
DVN	<i>Dan Viet Nam</i>	HOR	<i>History of Religions (Chicago)</i>
DZZ	<i>Deutsche Zahnärztlichen Zeit.</i>	HOSC	<i>History of Science (annual)</i>
		HRASP	<i>Histoire de l'Acad. Roy. des Sciences, Paris</i>
EARLH	<i>Earlham Review</i>	HSS	<i>Hsüeh Ssu (Thought and Learning), Chhêngtu</i>
EECN	<i>Electroencephalography and Clinical Neurophysiology</i>	HU/BML	<i>Harvard University Botanical Museum Leaflets</i>
EG	<i>Economic Geology</i>	HUM	<i>Humanist (RPA, London)</i>
EHOR	<i>Eastern Horizon (Hongkong)</i>		
EHR	<i>Economic History Review</i>	IA	<i>Iron Age</i>
EI	<i>Encyclopaedia of Islam</i>	IBK	<i>Indogaku Bukkyōgaku Kenkyū (Indian and Buddhist Studies)</i>
EMJ	<i>Engineering and Mining Journal</i>	IC	<i>Islamic Culture (Hyderabad)</i>
END	<i>Endeavour</i>	ID	<i>Idan (Medical Discussions), Japan</i>
EPJ	<i>Edinburgh Philosophical Journal (continued as ENPJ)</i>	IEC/AE	<i>Industrial and Engineering Chemistry; Analytical Edition</i>
ERE	<i>Encyclopaedia of Religion and Ethics</i>	IEC/I	<i>Industrial and Engineering Chemistry; Industrial Edition</i>
ERJB	<i>Eranos Jahrbuch</i>	IHQ	<i>Indian Historical Quarterly</i>
ERYB	<i>Eranos Yearbook</i>	IJE	<i>Indian Journ. Entomol.</i>
ETH	<i>Ethnos</i>	IJHM	<i>Indian Journ. History of Medicine</i>
EURR	<i>Europäische Revue (Berlin)</i>	IJHS	<i>Indian Journ. History of Science</i>
EXPED	<i>Expedition (Magazine of Archaeology and Anthropology), Philadelphia</i>	IJMR	<i>Indian Journ. Med. Research</i>
		IMIN	<i>Industria Mineraria</i>
FCON	<i>Fortschritte d. chemie d. organischen Naturstoffe</i>	IMW	<i>India Medical World</i>
FER	<i>Far Eastern Review (London)</i>	INDQ	<i>Industria y Química (Buenos Aires)</i>
FF	<i>Forschungen und Fortschritte</i>	INM	<i>International Nickel Magazine</i>
FMNHP/AS	<i>Field Museum of Natural History (Chicago) Publications; Anthropological Series</i>	IPEK	<i>Ipek; Jahrb. f. prähistorische u. ethnographische Kunst (Leipzig)</i>
FP	<i>Federation Proceedings (USA)</i>	IQB	<i>Iqbal (Lahore), later Iqbal Review (Journ. of the Iqbal Academy or Bazm-i Iqbal)</i>
FPNJ	<i>Folia Psychologica et Neurologica Japonica</i>	IRAQ	<i>Iraq (British Sch. Archaeol. in Iraq)</i>
FRS	<i>Franziskanischen Studien</i>	ISIS	<i>Isis</i>
GBA	<i>Gazette des Beaux-Arts</i>	ISTC	<i>I Shih Tsa Chih (Chinese Journal of the History of Medicine)</i>
GBT	<i>Global Technology</i>	IVS	<i>Ingeniörvidenskabelje Skrifter (Copenhagen)</i>
GEW	<i>Geloof en Wetenschap</i>		
GJ	<i>Geographical Journal</i>	JA	<i>Journal Asiatique</i>
GR	<i>Geographical Review</i>	JAC	<i>Jahrb. f. Antike u. Christentum</i>
GRM	<i>Germanisch-Romanische Monatschrift</i>	JACS	<i>Journ. Amer. Chem. Soc.</i>
GUJ	<i>Gutenberg Jahrbuch</i>	JAHS	<i>Journ. Asian History (International)</i>
HCA	<i>Helvetica Chimica Acta</i>	JAIMH	<i>Pratibha; Journ. All-India Instit. of Mental Health</i>
HE	<i>Hesperia (Journ. Amer. Sch. Class. Stud. Athens)</i>	JALCHS	<i>Journal of the Alchemical Society (London)</i>
HEJ	<i>Health Education Journal</i>	JAN	<i>Janus</i>
HERM	<i>Hermes; Zeitschr. f. Klass. Philol.</i>	JAOS	<i>Journal of the American Oriental Society</i>
HF	<i>Med Hammare och Fackla (Sweden)</i>	JAP	<i>Journ. Applied Physiol.</i>

JAS	<i>Journal of Asian Studies</i> (continuation of <i>Far Eastern Quarterly</i> , FEQ)	JRAS/P	<i>Journal of the (Royal) Asiatic Soc. of Pakistan</i>
JATBA	<i>Journal d'Agriculture tropicale et de Botanique appliqué</i>	JRIBA	<i>Journal. Royal Institute of British Architects</i>
JBC	<i>Journ. Biol. Chem.</i>	JRSA	<i>Journal of the Royal Society of Arts</i>
JBFIGN	<i>Jahresber. d. Forschungsinstitut f. Gesch. d. Naturwiss.</i> (Berlin)	JRS	<i>Journal des Sçavans</i> (1665-1778) and <i>Journal des Savants</i> (1816-)
JC	<i>Jinmin Chügoku</i> (People's China), Tokyo	JSA	<i>Journal de la Société des Américanistes</i>
JCE	<i>Journal of Chemical Education</i>	JSCI	<i>Journ. Soc. Chem. Industry</i>
JCP	<i>Jahrb. f. class. Philologie</i>	JSHS	<i>Japanese Studies in the History of Science</i> (Tokyo)
JCS	<i>Journal of the Chemical Society</i>	JUB	<i>Journ. Univ. Bombay</i>
JEA	<i>Journal of Egyptian Archaeology</i>	JUS	<i>Journ. Unified Science</i> (continuation of <i>Erkenntnis</i>)
JEGP	<i>Journal of English and Germanic Philology</i>	JWCBRS	<i>Journal of the West China Border Research Society</i>
JEH	<i>Journal of Economic History</i>	JWCI	<i>Journal of the Warburg and Courtauld Institutes</i>
JEM	<i>Journ. Exper. Med.</i>	JWH	<i>Journal of World History</i> (UNESCO)
JFI	<i>Journ. Franklin Institute</i>	KHS	<i>Kho Hsiieh</i> (Science)
JGGBB	<i>Jahrbuch d. Gesellschaft f. d. Gesch. u. Bibliographie des Brauwesens</i>	KHSC	<i>Kho-Hsiieh Shih Chi-Khan</i> (Ch. Journ. Hist. of Sci.)
JGMB	<i>Journ. Gen. Microbiol.</i>	KHTP	<i>Kho Hsiieh Thung Pao</i> (Science Correspondent)
JHI	<i>Journal of the History of Ideas</i>	KHVL	<i>Kungliga Humanistiska Vetenskapsamfundet i Lund Årskrift</i> (Bull. de la Soc. Roy. de Lettres de Lund)
JHMAS	<i>Journal of the History of Medicine and Allied Sciences</i>	KKD	<i>Kiuki Daigaku Sekai Keizai Kenkyūjo Hōkoku</i> (Reports of the Institute of World Economics at Kiuki Univ.)
JHS	<i>Journal of Hellenic Studies</i>	KKTH	<i>Khao Ku Thung Hsün</i> (Archaeological Correspondent), cont. as <i>Khao Ku</i>
JH	<i>Jissen Igaku</i> (Practical Medicine)	KKTS	<i>Ku Kung Thu Shu Chi Khan</i> (Journal of the Imperial Palace Museum and Library), Taiwan
JIM	<i>Journ. Institute of Metals</i> (UK)	KSVA/H	<i>Kungl. Svenske Vetenskapsakad. Handlingar</i>
JIMA	<i>Journ. Indian Med. Assoc.</i>	KVSUA	<i>Kungl. Vetenskaps Soc. i Uppsala Årsbok</i> (Mem. Roy. Acad. Sci. Uppsala)
JKHRS	<i>Journ. Kalinga Historical Research Soc.</i> (Orissa)	KW	<i>Klinische Wochenschrift</i>
JMBA	<i>Journ. of the Marine Biological Association</i> (Plymouth)	LA	<i>Annalen d. Chemie</i> (Liebig's)
JNMD	<i>Journ. Nervous & Mental Diseases</i>	LCHIND	<i>La Chimica e l'Industria</i> (Milan)
JMS	<i>Journ. Mental Science</i>	LEC	<i>Lettres Édifiantes et Curieuses écrites des Missions Étrangères</i> (Paris, 1702-1776)
JNPS	<i>Journ. Neuropsychiatr.</i>	LH	<i>L'Homme; Revue Française d'Anthropologie</i>
JOP	<i>Journ. Physiol.</i>	LIN	<i>L'Institut</i> (Journal Universel des Sciences et des Sociétés Savantes en France et à l'Étranger)
JOSHK	<i>Journal of Oriental Studies</i> (Hong-kong Univ.)	LN	<i>La Nature</i>
JP	<i>Journal of Philology</i>	LP	<i>La Pensée</i>
JPB	<i>Journ. Pathol. and Bacteriol.</i>		
JPC	<i>Journ. f. prakt. Chem.</i>		
JPCB	<i>Journ. Physical Chem.</i>		
JPH	<i>Journal de Physique</i>		
JPHS	<i>Journ. Pakistan Historical Society</i>		
JPHST	<i>Journ. Philos. Studies</i>		
JPOS	<i>Journal of the Peking Oriental Society</i>		
JRAI	<i>Journal of the Royal Anthropological Institute</i>		
JRAS	<i>Journal of the Royal Asiatic Society</i>		
JRAS/B	<i>Journal of the (Royal) Asiatic Society of Bengal</i>		
JRAS/BOM	<i>Journ. Roy. Asiatic Soc., Bombay Branch</i>		
JRAS/KB	<i>Journal (or Transactions) of the Korea Branch of the Royal Asiatic Society</i>		
JRAS/M	<i>Journal of the Malayan Branch of the Royal Asiatic Society</i>		
JRAS/NCB	<i>Journal (or Transactions) of the</i>		

LSYC	<i>Li Shih Yen Chiu (Journal of Historical Research)</i> , Peking	MM	<i>Mining and Metallurgy</i> (New York, contd. as <i>Mining Engineering</i>)
LSYKK	<i>Li Shih yü Khao Ku (History and Archaeology; Bulletin of the Shenyang Museum)</i> , Shenyang	MMN	<i>Materia Medica Nordmark</i>
LT	<i>Lancet</i>	MMVKH	<i>Mitteilungen d. Museum f. Völkerkunde</i> (Hamburg)
LYCH	<i>Lychmos (Annual of the Swedish Hist. of Sci. Society)</i>	MMW	<i>Münchener Medizinische Wochenschrift</i>
MAAA	<i>Memoirs Amer. Anthropological Association</i>	MOULA	<i>Memoirs of the Osaka University of Liberal Arts and Education</i>
MAI/NEM	<i>Mémoires de l'Académie des Inscriptions et Belles-Lettres</i> , Paris (<i>Notices et Extraits des MSS</i>)	MP	<i>Il Marco Polo</i>
MAIS/SP	<i>Mémoires de l'Acad. Impériale des Sciences</i> , St Pétersbourg	MPMH	<i>Memoirs of the Peabody Museum of American Archaeology and Ethnology</i> , Harvard University
MAS/B	<i>Memoirs of the Asiatic Society of Bengal</i>	MRASP	<i>Mémoires de l'Acad. Royale des Sciences</i> (Paris)
MB	<i>Monographiae Biologicae</i>	MRDTB	<i>Memoirs of the Research Dept. of Tōyō Bunko</i> (Tokyo)
MBLB	<i>May and Baker Laboratory Bulletin</i>	MRS	<i>Mediaeval and Renaissance Studies</i>
MBPB	<i>May and Baker Pharmaceutical Bulletin</i>	MS	<i>Monumenta Serica</i>
MCB	<i>Mélanges Chinois et Bouddhiques</i>	MSAF	<i>Mémoires de la Société (Nat.) des Antiquaires de France</i>
MCE	<i>Metallurgical and Chemical Engineering</i>	MSGVK	<i>Mitt. d. Schlesische Gesellschaft f. Volkskunde</i>
MCHSAMUC	<i>Mémoires concernant l'Histoire, les Sciences, les Arts, les Mœurs et les Usages, des Chinois, par les Missionnaires de Pékin</i> (Paris 1776-)	MSIV/MF	<i>Memoire di Mat. e. Fis della Soc. Ital.</i> (Verona)
MDGNVO	<i>Mitteilungen d. deutsch. Gesellsch. f. Natur. u. Volkskunde Ostasiens</i>	MSOS	<i>Mitteilungen d. Seminar f. orientalischen Sprachen</i> (Berlin)
MDP	<i>Mémoires de la Délégation en Perse</i>	MSP	<i>Mining and Scientific Press</i>
MED	<i>Medicus</i> (Karachi)	MUJ	<i>Museum Journal</i> (Philadelphia)
MEDA	<i>Medica</i> (Paris)	MUSEON	<i>Le Muséon</i> (Louvain)
METL	<i>Metallen</i> (Sweden)	N	<i>Nature</i>
MGG	<i>Monatsschrift f. Geburtshilfe u. Gynäkologie</i>	NAGE	<i>New Age</i> (New Delhi)
MGGW	<i>Mitteilungen d. geographische Gesellschaft Wien</i>	NAR	<i>Nutrition Abstracts and Reviews</i>
MGSC	<i>Memoirs of the Chinese Geological Survey</i>	NARSU	<i>Nova Acta Reg. Soc. Sci. Upsaliensis</i>
MH	<i>Medical History</i>	NC	<i>Numismatic Chronicle (and Journ. Roy. Numismatic Soc.)</i>
MI	<i>Metal Industry</i>	NCDN	<i>North China Daily News</i>
MIE	<i>Mémoires de l'Institut d'Egypte</i> (Cairo)	NCGH	<i>Nihon Chūgoku Gakkai-hō (Bulletin of the Japanese Sino-logical Society)</i>
MIFC	<i>Mémoires de l'Institut Français d'Archéol. Orientale</i> (Cairo)	NCH	<i>North China Herald</i>
MIK	<i>Mikrochemie</i>	NCR	<i>New China Review</i>
MIMG	<i>Mining Magazine</i>	NDI	<i>Niigata Daigaku Igakubu Gakushikai Kaihō (Bulletin of the Medical Graduate Society of Niigata University)</i>
MIT	<i>Massachusetts Institute of Technology</i>	NFR	<i>Nat. Fireworks Review</i>
MJ	<i>Mining Journal, Railway and Commercial Gazette</i>	NHK	<i>Nihon Heibon Keisha</i> (publisher)
MJA	<i>Med. Journ. Australia</i>	NIZ	<i>Nihon Ishigaku Zasshi (Jap. Journ. Hist. Med.)</i>
MJPGA	<i>Mitteilungen aus Justus Perthes Geogr. Anstalt</i> (Petermann's)	NN	<i>Nation</i>
MKDUS/HF	<i>Meddelelser d. Kgl. Danske Videnskabernes Selskab</i> (Hist.-Filol.)	NQ	<i>Notes and Queries</i>
		NR	<i>Numismatic Review</i>
		NRRS	<i>Notes and Records of the Royal Society</i>
		NS	<i>New Scientist</i>
		NSN	<i>New Statesman and Nation</i> (London)

NU	<i>The Nucleus</i>	QSGNM	<i>Quellen u. Studien z. Gesch. d. Naturwiss. u. d. Medizin (continuation of Archiv. f. Gesch. d. Math., d. Naturwiss. u. d. Technik, AGMNT, formerly Archiv. f. d. Gesch. d. Naturwiss. u. d. Technik, AGNT)</i>
NUM SHR	<i>Studies in the History of Religions (Supplements to Numen)</i>		
NW	<i>Naturwissenschaften</i>		
OAZ	<i>Ostasiatische Zeitschrift</i>		
ODVS	<i>Oversigt over det k. Danske Videnskabernes Selskabs Forhandlinger</i>	QSKMR	<i>Quellenschriften f. Kunstgeschichte und Kunsttechnik des Mittelalters u. d. Renaissance (Vienna)</i>
OE	<i>Oriens Extremus (Hamburg)</i>		
OLZ	<i>Orientalische Literatur-Zeitung</i>		
ORA	<i>Oriental Art</i>		
ORCH	<i>Orientalia Christiana</i>	RA	<i>Revue Archéologique</i>
ORD	<i>Ordance</i>	RAA AMG	<i>Revue des Arts Asiatiques (Annales du Musée Guimet)</i>
ORG	<i>Organon (Warsaw)</i>		
ORR	<i>Orientalia (Rome)</i>	RAAAS	<i>Reports, Australasian Assoc. Adv. of Sci.</i>
ORS	<i>Orientalia Suecana</i>		
OSIS	<i>Osiris</i>	RAAO	<i>Revue d'Assyriologie et d'Archéologie Orientale</i>
OUP	<i>Oxford University Press</i>	RALUM	<i>Revue de l'Aluminium</i>
OUSS	<i>Ochanomizu University Studies</i>	RB	<i>Revue Biblique</i>
OX	<i>Oxoniensia</i>	RBPH	<i>Revue Belge de Philol. et d'Histoire</i>
PAAAS	<i>Proceedings of the American Acad. of Arts and Sciences</i>	RBS	<i>Revue Bibliographique de Sinologie</i>
PAAQS	<i>Proceedings of the American Antiquarian Society</i>	RDM	<i>Revue des Mines (later Revue Universelle des Mines)</i>
PAI	<i>Paideuma</i>	RGVV	<i>Religionsgeschichtliche Versuche und Vorarbeiten</i>
PAKJS	<i>Pakistan Journ. Sci.</i>	RHR AMG	<i>Revue de l'Histoire des Religions (Annales du Musée Guimet, Paris)</i>
PAKPY	<i>Pakistan Philos. Journ.</i>		
PAPS	<i>Proc. Amer. Philos. Soc.</i>	RHS	<i>Revue d'Histoire des Sciences</i>
PCASC	<i>Proc. Cambridge Antiquarian Soc.</i>	RHSID	<i>Revue d'Histoire de la Sidérurgie (Nancy)</i>
PEW	<i>Philosophy East and West (Univ. Hawaii)</i>	RIN	<i>Rivista Italiana di Numismatica</i>
PF	<i>Psychologische Forschung</i>	RKW	<i>Repertorium f. Kunst. wissenschaft</i>
PHI	<i>Die Pharmazeutische Industrie</i>	RMV	<i>Revue de Mycologie</i>
PHREV	<i>Pharmacological Reviews</i>	ROC	<i>Revue de l'Orient Chrétien</i>
PHY	<i>Physis (Florence)</i>	RP	<i>Revue Philosophique</i>
PJ	<i>Pharmaceut. Journal (and Trans. Pharmaceut. Soc.)</i>	RPA	<i>Rationalist Press Association (London)</i>
PKAWA	<i>Proc. Kon. Akad. Wetensch. Amsterdam</i>	RPCHG	<i>Revue de Pathologie comparée et d'Hygiène générale (Paris)</i>
PKR	<i>Peking Review</i>	RPLHA	<i>Revue de Philol., Litt. et Hist. Ancienne</i>
PM	<i>Presse Medicale</i>	RR	<i>Review of Religion</i>
PMG	<i>Philosophical Magazine</i>	RSCI	<i>Revue Scientifique (Paris)</i>
PMLA	<i>Publications of the Modern Language Association of America</i>	RSH	<i>Revue de Synthèse Historique</i>
PNHB	<i>Peking Natural History Bulletin</i>	RSI	<i>Reviews of Scientific Instruments</i>
POLYJ	<i>Polytechnisches Journal (Dingler's)</i>	RSO	<i>Rivista di Studi Orientali</i>
PPHS	<i>Proceedings of the Prehistoric Society</i>	RUB	<i>Revue de l'Univ. de Bruxelles</i>
PRGS	<i>Proceedings of the Royal Geographical Society</i>		
PRIA	<i>Proceedings of the Royal Irish Academy</i>	S	<i>Sinologica (Basel)</i>
PRPH	<i>Produits Pharmaceutiques</i>	SA	<i>Sinica (originally Chinesische Blätter f. Wissenschaft u. Kunst)</i>
PRSA	<i>Proceedings of the Royal Society (Series A)</i>	SAEC	<i>Supplemento Annuale all'Enciclopedia di Chimica</i>
PRSB	<i>Proceedings of the Royal Society (Series B)</i>	SAEP	<i>Soc. Anonyme des Études et Pub. (publisher)</i>
PRSM	<i>Proceedings of the Royal Society of Medicine</i>	SAM	<i>Scientific American</i>
PSEBM	<i>Proc. Soc. Exp. Biol. and Med.</i>	SB	<i>Shizen to Bunka (Nature and Culture)</i>
PTRS	<i>Philosophical Transactions of the Royal Society</i>		

SBE	<i>Sacred Books of the East series</i>	TAIMME	<i>Transactions of the American Institute of Mining and Metallurgical Engineers</i>
SBK	<i>Seikatsu Bunka Kenkyū (Journ. Econ. Cult.)</i>		
SBM	<i>Svenska Bryggareföreningens Månadsblad</i>	TAPS	<i>Transactions of the American Philosophical Society (cf. MAPS)</i>
SC	<i>Science</i>		
SCI	<i>Scientia</i>	TAS/J	<i>Transactions of the Asiatic Society of Japan</i>
SCIS	<i>Sciences; Revue de la Civilisation Scientifique (Paris)</i>	TBKK	<i>Tōhoku Bunka Kenkyūshitsu Kiyō (Record of the North-Eastern Research Institute of Humanistic Studies), Sendai</i>
SCISA	<i>Scientia Sinica (Peking)</i>		
SCK	<i>Smithsonian Contributions to Knowledge</i>	TCS	<i>Trans. Ceramic Society (formerly Trans. Engl. Cer. Soc., contd as Trans. Brit. Cer. Soc.)</i>
SCM	<i>Student Christian Movement (Press)</i>	TCULT	<i>Technology and Culture</i>
SCON	<i>Studies in Conservation (Journ. Internat. Instit. for the Conservation of Museum objects)</i>	TFTC	<i>Tung Fang Tsa Chih (Eastern Miscellany)</i>
SET	<i>Structure et Evolution des Techniques</i>	TGAS	<i>Transactions of the Glasgow Archaeological Society</i>
SGZ	<i>Shigaku Zasshi (Historical Journ. of Japan)</i>	TG/T	<i>Tōhō Gakuhō, Tōkyō (Tokyo Journal of Oriental Studies)</i>
SHA	<i>Shukan Asahi</i>	TH	<i>Thien Hsia Monthly (Shanghai)</i>
SHAW/PH	<i>Sitzungsber. d. Heidelberg. Akad. d. Wissensch. (Phil.-Hist. Kl.)</i>	THG	<i>Tōhōgaku (Eastern Studies), Tokyo</i>
SHST/T	<i>Studies in the History of Science and Technol. (Tokyo Univ. Inst. Technol.)</i>	TICE	<i>Transactions of the Institute of Chemical Engineers</i>
SI	<i>Studia Islamica (Paris)</i>	TIMM	<i>Transactions of the Institution of Mining and Metallurgy</i>
SIB	<i>Sibirium (Collana di Studi e Documentazioni, Centro di Studi Preistorici e Archeologici Varese)</i>	TJSL	<i>Transactions (and Proceedings) of the Japan Society of London</i>
SILL	<i>Sweden Illustrated</i>	TLTC	<i>Ta Lu Tsa Chih (Continent Magazine), Taipei</i>
SK	<i>Seminarium Kondakovianum (Recueil d'Études de l'Institut Kondakov)</i>	TMIE	<i>Travaux et Mémoires de l'Inst. d'Ethnologie (Paris)</i>
SM	<i>Scientific Monthly (formerly Popular Science Monthly)</i>	TNS	<i>Transactions of the Newcomen Society</i>
SN	<i>Shirin (Journal of History), Kyoto</i>	TOCS	<i>Transactions of the Oriental Ceramic Society</i>
SNM	<i>Sbornik Nauknykh Materialov (Erivan, Armenia)</i>	TP	<i>T'oung Pao (Archives concernant l'Histoire, les Langues, la Géographie, l'Ethnographie et les Arts de l'Asie Orientale), Leiden</i>
SOS	<i>Semitic and Oriental Studies (Univ. of Calif. Publ. in Semitic Philol.)</i>	TQ	<i>Tel Quel (Paris)</i>
SP	<i>Speculum</i>	TR	<i>Technology Review</i>
SPAW/PH	<i>Sitzungsber. d. preuss. Akad. d. Wissenschaften (Phil.-Hist. Kl.)</i>	TRAD	<i>Tradition (Zeitschr. f. Firmengeschichte und Unternehmerbiographie)</i>
SPCK	<i>Society for the Promotion of Christian Knowledge</i>	TRSC	<i>Trans. Roy. Soc. Canada</i>
SPMSE	<i>Sitzungsberichte d. physik. med. Soc. Erlangen</i>	TS	<i>Tōhō Shūkyō (Journal of East Asian Religions)</i>
SPR	<i>Science Progress</i>	TSFFA	<i>Techn. Studies in the Field of the Fine Arts</i>
SSIP	<i>Shanghai Science Institute Publications</i>	TTT	<i>Theoria to Theory (Cambridge)</i>
STM	<i>Studi Medievali</i>	TYG	<i>Tōyō Gakuhō (Reports of the Oriental Society of Tokyo)</i>
SWAW/PH	<i>Sitzungsberichte d. k. Akad. d. Wissenschaften Wien (Phil.-Hist. Klasse), Vienna</i>	TYGK	<i>Tōyōgaku (Oriental Studies), Sendai</i>
		TYKK	<i>Thien Yeh Khao Ku Pao Kao (Archaeological Reports)</i>
TAF	<i>Transactions of the American Foundrymen's Association</i>	UCC	<i>University of California Chronicle</i>
TAIME	<i>Trans. Amer. Inst. Mining Engineers (continued as TAIMME)</i>	UCR	<i>University of Ceylon Review</i>

UNASIA	United Asia (India)		ence Materials for History and Archaeology)
UNESC	Unesco Courier		Wiener Zeitschr. f. Nervenheil-
UNESCO	United Nations Educational, Scientific and Cultural Organization	WZNHK	kunde
UUA	Uppsala Univ. Årsskrift (<i>Acta Univ. Upsaliensis</i>)	YCHP	Yenching Hsüeh Pao (Yenching University Journal of Chinese Studies)
VBA	Visva-Bharati Annals	YJBM	Yale Journal of Biology and Medicine
VBW	Vorträge d. Bibliothek Warburg		Yenching Journal of Social Studies
VK	Vijnan Karmee	YJSS	
VKAWA/L	Verhandelingen d. Koninklijke Akad. v. Wetenschappen te Amsterdam (Afd. Letterkunde)	Z	Zalmoxis; Revue des Études Religieuses
VMAWA	Verslagen en Meded. d. Koninklijke Akad. v. Wetenschappen te Amsterdam	ZAC	Zeitschr. f. angewandte chemie
		ZAC/AC	Angewandte Chemie
VVBGP	Verhandlungen d. Verein z. Beförderung des Gewerbefleißes in Preussen	ZAES	Zeitschrift f. Aegyptische Sprache u. Altertumskunde
		ZASS	Zeitschr. f. Assyriologie
		ZDMG	Zeitschrift d. deutsch. Morgenländischen Gesellschaft
WA	Wissenschaftliche Annalen	ZGEB	Zeitschr. d. Gesellsch. f. Erdkunde (Berlin)
WKW	Wiener klinische Wochenschrift		Zeitschrift f. Math. u. Physik
WS	Wên Shih (History of Literature), Peking	ZMP	Zeitschr. f. physiologischen Chemie
WWTK	Wên Wu (formerly Wên Wu Tshan Khao Tzu Liao, Refer-	ZS	Zeitschr. f. Semitistik
		ZVSF	Zeitschr. f. vergl. Sprachforschung

A. CHINESE AND JAPANESE BOOKS BEFORE +1800

Each entry gives particulars in the following order:

- (a) title, alphabetically arranged, with characters;
- (b) alternative title, if any;
- (c) translation of title;
- (d) cross-reference to closely related book, if any;
- (e) dynasty;
- (f) date as accurate as possible;
- (g) name of author or editor, with characters;
- (h) title of other book, if the text of the work now exists only incorporated therein; or, in special cases, references to sinological studies of it;
- (i) references to translations, if any, given by the name of the translator in Bibliography C;
- (j) notice of any index or concordance to the book if such a work exists;
- (k) reference to the number of the book in the *Tao Tsang* catalogue of Wieger (6), if applicable;
- (l) reference to the number of the book in the *San Tsang* (Tripitaka) catalogues of Nanjio (1) and Takakusu & Watanabe, if applicable.

Words which assist in the translation of titles are added in round brackets.

Alternative titles or explanatory additions to the titles are added in square brackets.

It will be remembered (p. 305 above) that in Chinese indexes words beginning *Chh-* are all listed together after *Ch-*, and *Hs-* after *H-*, but that this applies to initial words of titles only.

A-Nan Ssu Shih Ching 阿難四事經.

Sūtra on the Four Practices spoken to Ānanda.

India.

Tr. San Kuo, betw. +222 and +230 by

Chih-Chhien 支謙.

N/696; TW/493.

A-Phi-Tham-Phi Po-Sha Lun 阿毘曇

毘婆沙論.

Abhidharma Mahāvibhāṣa.

India (this recension not much before +600).

Tr. Hsüan-Chuang, +659 玄奘.

N/1263; TW/1546.

Chang Chen-Yen Chin Shih Ling Sha Lun.

See *Chin Shih Ling Sha Lun*.

Chao Fei-Yen Pieh Chuan 趙飛燕別傳.

[= *Chao Hou I Shih*.]

Another Biography of Chao Fei-Yen [historical novelette].

Sung.

Chhin Shun 秦醇.

Chao Fei-Yen Wai Chuan 趙飛燕外傳.

Unofficial Biography of Chao Fei-Yen

(d. -6, celebrated dancing-girl, consort and empress of Han Chhêng Ti).

Ascr. Han, +1st.

Attrib. Ling Hsüan 伶玄.

Chao Hou I Shih 趙后遺事.

A Record of the Affairs of the Empress

Chao (-1st century).

See *Chao Fei-Yen Pieh Chuan*.

Where there are any differences between the entries in these bibliographies and those in Vols. 1-4, the information here given is to be taken as more correct.

An interim list of references to the editions used in the present work, and to the *tshung-shu* collections in which books are available, has been given in Vol. 4, pt. 3, pp. 913 ff., and is available as a separate brochure.

ABBREVIATIONS

C/Han	Former Han.
E/Wei	Eastern Wei.
H/Han	Later Han.
H/Shu	Later Shu (Wu Tai).
H/Thang	Later Thang (Wu Tai).
H/Chin	Later Chin (Wu Tai).
S/Han	Southern Han (Wu Tai).
S/Phing	Southern Phing (Wu Tai).
J/Chin	Jurchen Chin.
L/Sung	Liu Sung.
N/Chou	Northern Chou.
N/Chhi	Northern Chhi.
N/Sung	Northern Sung (before the removal of the capital to Hangchow).
N/Wei	Northern Wei.
S/Chhi	Southern Chhi.
S/Sung	Southern Sung (after the removal of the capital to Hangchow).
W/Wei	Western Wei.

Chao Hun 招魂.

The Summons of the Soul [ode].

Chou (Chhu), c. -240.

Prob. Ching Chhai 景差.

Tr. Hawkes (1), p. 103.

Chen Chhi Huan Yuan Ming 眞氣還元銘.

The Inscription on the Regeneration of the Primary Chhi.

Thang or Sung, must be before the mid +13th century.

Writer unknown.

TT/261.

Chen Chung Chi 枕中記.

[= *Ko Hung Chen Chung Shu*.]

Pillow-Book (of Ko Hung).

Ascr. Chin, c. +320, but actually not earlier than the +7th century.

Attrib. Ko Hung 葛洪.

TT/830.

Chen Chung Chi 枕中記.

See *Shê Yang Chen Chung Chi*.

Chen-Chung Hung-Pao Yuan-Pi Shu 枕中鴻寶苑祕書.

The Infinite Treasure of the Garden of Secrets; (Confidential) Pillow-Book (of the Prince of Huai-Nan).

See *Huai-Nan Wang Wan Pi Shu*.

Cf. Kaltenmark (2), p. 32.

Chen Hsi 眞系.

The Legitimate Succession of Perfected, or Realised, (Immortals).

Thang, +805.

Li Po 李渤.

In YCCC, ch. 5, pp. 1 a ff.

- Chen Kao* 眞誥.
Declarations of Perfected, or Realised,
(Immortals) [visitations and revelations of
the Taoist pantheon].
Chin and S/Chhi. Original material from
+364 to +370, collected from +484 to
+492 by Thao Hung-Ching (+456 to
+536), who provided commentary and
postface by +493 to +498; finished
+499.
Original writers unknown.
Ed. Thao Hung-Ching 陶弘景.
TT/1004.
- Chen Yuan Miao Tao Hsiu Tan Li Yen Chhao*
眞元妙道修丹歷驗抄.
[= *Hsiu Chen Li Yen Chhao Thu*.]
A Document concerning the Tried and
Tested (Methods for Preparing the)
Restorative Enchymoma of the Mysterious
Tao of the Primary (Vitalities) [physio-
logical alchemy].
Thang or Sung, before +1019.
Tung Chen Tzu (ps.) 洞眞子.
In YCCC, ch. 72, pp. 17b ff.
- Chen Yuan Miao Tao Yao Lueh* 眞元妙道要畧.
Classified Essentials of the Mysterious Tao
of the True Origin (of Things) [alchemy
and chemistry].
Ascr. Chin, +3rd, but probably mostly
Thang, +8th and +9th, at any rate
after +7th as it quotes Li Chi.
Attrib. Cheng Ssu-Yuan 鄭思遠.
TT/917.
- Cheng I Fa Wen (Thai-Shang) Wai Lu I* 正一法
文太上外錄儀.
The System of the Outer Certificates, a Thai-
Shang Scripture.
Date unknown, but pre-Thang.
Writer unknown.
TT/1225.
- Cheng Lei Pên Tshao* 證類本草.
See *Ching-Shih Cheng Lei Pei-Chi Pên Tshao*
and *Chung-Hsiu Cheng-Ho Ching-Shih*
Cheng Lei Pei-Yung Pên Tshao
- Cheng Tao Pi Shu Shih Chung* 證道秘書十種.
Ten Types of Secret Books on the Verifica-
tion of the Tao.
See Fu Chin-Chhuan (6)
- Chi Hsiao Hsin Shu* 紀效新書.
A New Treatise on Military and Naval
Efficiency.
Ming, c. +1575.
Chhi Chi-Kuang 戚繼光.
- Chi Hsien Chuan* 集仙傳.
Biographies of the Company of the Immortals.
Sung, c. +1140.
Tsêng Tshao 曾慥.
- Chi I Chi* 集異記.
A Collection of Assorted Stories of Strange
Events.
Thang.
Hsüeh Yung-Jo 薛用弱.
- Chi Ni Tzu* 計倪子.
[= *Fan Tzu Chi Jan* 范子計然.]
The Book of Master Chi Ni.
Chou (Yüeh), -4th century.
Attrib. Fan Li 范蠡, recording the
philosophy of his master Chi Jan 計然.
- Chi Shêng Fang* 濟生方.
Prescriptions for the Preservation of Health.
Sung, c. +1267.
Yen Yung-Ho 嚴用和.
- Chi Than Lu* 劇談錄.
Records of Entertaining Conversations.
Thang, c. +885.
Khang Phien 康駢 or 駢.
- Chi Yün* 集韻.
Complete Dictionary of the Sounds of
Characters [cf. *Chieh Yün* and *Kuang*
Yün].
Sung, +1037.
Compiled by Ting Tu 丁度 *et al.*
Possibly completed in +1067 by Ssuma
Kuang 司馬光.
- Chia-Yu Pên Tshao* 嘉祐本草.
See *Chia-Yu Pu-Chu Shen Nung Pên Tshao*.
- Chia-Yu Pu-Chu Shen Nung Pên Tshao* 嘉祐補
註神農本草.
Supplementary Commentary on the *Pharma-
copoeia of the Heavenly Husbandman*,
commissioned in the Chia-Yu reign-
period.
Sung, commissioned +1057, finished
+1060.
Chang Yü-Hsi 掌禹錫,
Lin I 林億,
& Chang Tung 張洞.
- Chiang Huai I Jen Lu* 江淮異人錄.
Records of (Twenty-five) Strange Magician-
Technicians between the Yangtze and the
Huai River (during the Thang, Wu and
Nan Thang Dynasties, c. +850 to +950).
Sung, c. +975.
Wu Shu 吳淑.
- Chiang Wên-Thung Chi* 江文通集.
Literary Collection of Chiang Wên-Thung
(Chiang Yen).
S/Chhi, c. +500.
Chiang Yen 江淹.
- Chiao Chhuang Chiu Lu* 蕉窗九錄.
Nine Dissertations from the (Desk at the)
Banana-Grove Window.
Ming, c. +1575.
Hsiang Yuan-Pien 項元汴.
- Chien Wu Chi* 漸悟集.
On the Gradual Understanding (of the
Tao).
Sung, mid +12th century.
Ma Yü 馬鈺.
TT/1128.
- Chih Chen Tzu Lung Hu Ta Tan Shih* 至眞子
龍虎大丹詩.
Song of the Great Dragon-and-Tiger En-
chymoma of the Perfected-Truth Master.

- Chih Chen Tzu Lung Hu Ta Tan Shih* (cont.)
Sung, +1026.
Chou Fang (Chih Chen Tzu) 周方.
Presented to the throne by Lu Thien[-Chi]
盧天驥, c. +1115.
TT/266.
- Chih-Chhuan Chen-jen Chiao Chêng Shu* 稚川
真人校證術.
Technical Methods of the Adept (Ko) Chih-
Chhuan (i.e. Ko Hung), with Critical
Annotations [and illustrations of al-
chemical apparatus].
Ascr. Chin, c. +320, but probably later.
Attrib. Ko Hung 葛洪.
TT/895.
- Chih Chih Hsiang Shuo San Chhêng Pi Yao* 直
指詳說三乘秘要.
See *Wu Chen Phien Chih Chih Hsiang Shuo
San Chhêng Pi Yao*.
Cf. Davis & Chao Yün-Tshung (6).
- Chih-Chou hsien-sêng Chün Tan Chih Chih* 紙舟
先生金丹直指.
Straightforward Indications about the
Metallous Enchymoma by the Paper-
Boat Teacher.
Sung, prob. +12th.
Chin Yüeh-Yen 金月嚴.
TT/239.
- Chih Hsüan Phien* 指玄篇.
A Pointer to the Mysteries [psycho-physio-
logical alchemy].
Sung, c. +1215.
Pai Yü-Chhan 白玉蟾.
In *Hsiu Chen Shih Shu* (TT/260), chs. 1-8.
- Chih Kuei Chi* 指歸集.
Pointing the Way Home (to Life Eternal); a
Collection.
Sung, c. +1165.
Wu Wu 吳悞.
TT/914.
Cf. Chhen Kuo-Fu (1), vol. 2, pp. 389,
390.
- Chih Tao Phien* 旨道篇 (or 編).
A Demonstration of the Tao.
Sui or just before, c. +580.
Su Yuan-Ming (or -Lang) 蘇元明 (朗)
= Chhing Hsia Tzu 青霞子.
Now extant only in quotations.
- Chih Tshao Thu* 芝草圖.
See *Thai-Shang Ling-Pao Chih Tshao Thu*.
- Chin Hua Chhung Pi Tan Ching Pi Chih* 金華
冲碧丹經秘旨.
Confidential Instructions on the Manual of
the Heaven-Piercing Golden Flower
Elixir [with illustrations of alchemical
apparatus].
Sung, +1225.
Phêng Ssu 彭耆 & Mêng Hsü 孟照
(pref. and ed. Mêng Hsü).
Received from Pai Yü-Chhan 白玉蟾 and
Lan Yuan-Lao 蘭元老.
TT/907.

- The authorship of this important work is
obscure. In his preface Mêng Hsü says
that in +1218 he met in the mountains
Phêng Ssu, who transmitted to him a
short work which Phêng himself had re-
ceived from Pai Yü-Chhan. This is ch. 1
of the present book. Two years later Mêng
met an adept named Lan Yuan-Lao, who
claimed to be an avatar of Pai Yü-Chhan
and transmitted to Mêng a longer text;
this is the part which contains descriptions
of the complicated alchemical apparatus
and appears as ch. 2 of the present work.
The name of the book is taken from that
of the alchemical laboratory of Lan Yuan-
Lao, which was called Chin Hua Chhung
Pi Tan Shih 金華冲碧丹室.
- Chin Hua Tsung Chih* 金華宗旨
[= *Thai-I Chin Hua Tsung Chih*, also entitled
Chhang Shêng Shu; former title: *Lü
Tsu Chhuan Shou Tsung Chih*.]
Principles of the (Inner) Radiance of the
Metallous (Enchymoma) [a Taoist *nei tan*
treatise on meditation and sexual tech-
niques, with Buddhist influence].
Ming and Chhing, c. +1403, finalised
+1663, but may have been transmitted
orally from an earlier date. Present title
from +1668.
Writer unknown. Attrib. Lü Yen 呂頤
(Lü Tung-Pin) and his school, late
+8th.
Commentary by Tan Jan-Hui 澹然齋
(1921).
Prefaces by Chang San-Fêng 張三峯
(c. +1410) and several others, some per-
haps apocryphal.
See also *Lü Tsu Shih Hsien-Thien Hsü Wu
Thai-I Chin Hua Tsung Chih*.
Cf. Wilhelm & Jung (1).
- Chin Hua Yü I Ta Tan* 金華玉液大丹.
The Great Elixir of the Golden Flower (or,
Metallous Radiance) and the Juice of
Jade.
Date unknown, probably Thang.
Writer unknown.
TT/903.
- Chin Hua Yü Nü Shuo Tan Ching* 金華玉女
說丹經.
Sermon of the Jade Girl of the Golden
Flower about Elixirs and Enchymomas.
Wu Tai or Sung.
Writer unknown.
In YCCC, ch. 64, pp. 1 a ff.
- Chin I Huan Tan Pai Wên Chüeh* 金液還丹百
問訣.
Questions and Answers on Potable Gold
(Metallous Fluid) and Cyclically-
Transformed Elixirs and Enchymomas.
Sung.
Li Kuang-Hsüan 李光玄.
TT/263.

- Chin I Huan Tan Yin Cheng Thu* 金液還丹印證圖.
Illustrations and Evidential Signs of the Regenerative Enchymoma (constituted by, or elaborated from) the Metallous Fluid.
Sung, prob. +12th, perhaps c. +1218, date of preface.
Lung Mei Tzu (ps.) 龍眉子.
TT/148.
- Chin Ku Chhi Kuan* 今古奇觀.
Strange Tales New and Old.
Ming, c. +1620; pr. betw. +1632 and +1644.
Feng Meng-Lung 馮夢龍.
Cf. Pelliot (57).
- Chin Mu Wan Ling Lun* 金木萬靈論.
Essay on the Tens of Thousands of Efficacious (Substances) among Metals and Plants.
Ascr. Chin, c. +320. Actually prob. late Sung or Yuan.
Attrib. Ko Hung 葛洪.
TT/933.
- Chin Pi Wu Hsiang Lei Tshan Thung Chhi* 金碧五相類參同契.
Gold and Caerulean Jade Treatise on the Similarities and Categories of the Five (Substances) and the Kinship of the Three [a poem on physiological alchemy].
Ascr. H/Han, c. +200.
Attrib. Yin Chhang-Shêng 陰長生.
TT/897.
Cf. Ho Ping-Yü (12).
Not to be confused with the *Tshan Thung Chhi Wu Hsiang Lei Pi Yao*, q.v.
- Chin Shih Ling Sha Lun* 金石靈砂論.
A Discourse on Metals, Minerals and Cinnabar (by the Adept Chang).
Thang, between +713 and +741.
Chang Yin-Chü 張隱居.
TT/880.
- Chin Shih Pu Wu Chiu Shu Chüeh* 金石簿五九數訣.
Explanation of the Inventory of Metals and Minerals according to the Numbers Five (Earth) and Nine (Metal) [catalogue of substances with provenances, including some from foreign countries].
Thang, perhaps c. +670 (contains a story relating to +664).
Writer unknown.
TT/900.
- Chin Shih Wu Hsiang Lei* 金石五相類.
[= *Yin Chen Chün Chin Shih Wu Hsiang Lei*.]
The Similarities and Categories of the Five (Substances) among Metals and Minerals (sulphur, realgar, orpiment, mercury and lead) (by the Deified Adept Yin).
Date unknown (ascr. +2nd or +3rd century).
- Attrib. Yin Chen-Chün 陰真君 (Yin Chhang-Shêng).
TT/899.
- Chin Tan Chen Chuan* 金丹真傳.
A Record of the Primary (Vitalities, regained by) the Metallous Enchymoma.
Ming, +1615.
Sun Ju-Chung 孫汝忠.
- Chin Tan Cheng Li Ta Chhuan* 金丹正理大全.
Comprehensive Collection of Writings on the True Principles of the Metallous Enchymoma [a florilegium].
Ming, c. +1440.
Ed. Han Chhan Tzu 涵蟾子.
Cf. Davis & Chao Yün-Tshung (6).
- Chin Tan Chieh Yao* 金丹節要.
Important Sections on the Metallous Enchymoma.
Part of *San-Feng Tan Chüeh* (q.v.).
- Chin Tan Chih Chih* 金丹直指.
Straightforward Explanation of the Metallous Enchymoma.
Sung, prob. +12th.
Chou Wu-So 周無所.
TT/1058.
Cf. Chih-Chou hsien-sêng *Chin Tan Chih Chih*.
See Chhen Kuo-Fu (1), vol. 2, pp. 447 ff.
- Chin Tan Chin Pi Chhien Thung Chüeh* 金丹金碧潛通訣.
Oral Instructions explaining the Abscondite Truths of the Gold and Caerulean Jade (Components of the) Metallous Enchymoma.
Date unknown, not earlier than Wu Tai.
Writer unknown.
Incomplete in YCCC, ch. 73, pp. 7a ff.
- Chin Tan Fu* 金丹賦.
Rhapsodical Ode on the Metallous Enchymoma.
Sung, +13th.
Writer unknown.
Comm. by Ma Li-Chao 馬縉昭.
TT/258.
Cf. *Nei Tan Fu*, the text of which is very similar.
- Chin Tan Lung Hu Ching* 金丹龍虎經.
Gold Elixir Dragon and Tiger Manual.
Thang or early Sung.
Writer unknown.
Extant only in quotations, as in *Chu Chia Shen Phin Tan Fa*, q.v.
- Chin Tan Pi Yao Tshan Thung Lu* 金丹秘要參同錄.
Essentials of the Gold Elixir; a Record of the Concordance (or Kinship) of the Three.
Sung.
Meng Yao-Fu 孟要甫.
In *Chu Chia Shen Phin Tan Fa*, q.v.
- Chin Tan Su Pai Tzu* 金丹四百字.
The Four-Hundred Word Epitome of the Metallous Enchymoma.

- Chin Tan Ssu Pai Tzu* (cont.)
Sung, c. +1065.
Chang Po-Tuan 張伯端.
In *Hsiu Chen Shih Shu* (TT/260), ch. 5,
pp. 1a ff.
TT/1067.
Comms. by Phêng Hao-Ku and Min I-Tê
in *Tao Tsang Hsü Pien* (Chhu chi), 21.
Tr. Davis & Chao Yün-Tshung (2).
- Chin Tan Ta Chheng* 金丹大成.
Compendium of the Metallous Enchymoma.
Sung, just before +1250.
Hsiao Thing-Chih 蕭廷芝.
In *TTCY* (mao chi, 4), and in *TT*/260,
Hsiu Chen Shih Shu, chs. 9-13 incl.
- Chin Tan Ta Yao* 金丹大要.
[= *Shang Yang Tzu Chin Tan Ta Yao*.]
Main Essentials of the Metallous Enchy-
moma; the true Gold Elixir.
Yuan, +1331 (pref. +1335).
Chhen Chih-Hsü 陳致虛
(Shang Yang Tzu 上陽子).
In *TTCY* (mao chi, 1, 2, 3).
TT/1053.
- Chin Tan Ta Yao Hsien Phai* (Yuan Liu) 金丹
大要仙派源流.
[= *Shang Yang Tzu Chin Tan Ta Yao
Hsien Phai*.]
A History of the Schools of Immortals
mentioned in the *Main Essentials of the
Metallous Enchymoma; the true Gold Elixir*.
Yuan, c. +1333.
Chhen Chih-Hsü 陳致虛
(Shang Yang Tzu 上陽子).
In *TTCY*, *Chin Tan Ta Yao*, ch. 3, pp.
40 ff.
TT/1056.
- Chin Tan Ta Yao Lieh Hsien Chih* 金丹大要
列仙誌.
[= *Shang Yang Tzu Chin Tan Ta Yao Lieh
Hsien Chih*.]
Records of the Immortals mentioned in the
*Main Essentials of the Metallous Enchy-
moma; the true Gold Elixir*.
Yuan, c. +1333.
Chhen Chih-Hsü 陳致虛
(Shang Yang Tzu 上陽子).
TT/1055.
- Chin Tan Ta Yao Pao Chüeh* 金丹大藥寶訣.
Precious Instructions on the Great Medi-
cines of the Golden Elixir (Type).
Sung, c. +1045.
Tshui Fang 崔昉.
Preface preserved in *Keng Tao Chi*, ch. 1,
p. 8b, but otherwise only extant in
occasional quotations.
Perhaps the same book as the *Wai Tan
Pên Tshao* (q. v.).
- Chin Tan Ta Yao Thu* 金丹大要圖.
[= *Shang Yang Tzu Chin Tan Ta Yao Thu*.]
Illustrations for the *Main Essentials of the
Metallous Enchymoma; the true Gold Elixir*.
Yuan, +1333.
Chhen Chih-Hsü 陳致虛
(Shang Yang Tzu 上陽子).
Based on drawings and tables of the +10th
century onwards by Phêng Hsiao 彭曉,
Chang Po-Tuan 張伯端 (hence the
name *Tzu Yang Tan Fang Pao Chien
Thu*), Lin Shen-Fêng 林神鳳 and
others.
In *TTCY* (*Chin Tan Ta Yao*, ch. 3,
pp. 26a ff.).
TT/1054.
Cf. Ho Ping-Yü & Needham (2).
- Ching Chhu Sui Shih Chi* 荆楚歲時記.
Annual Folk Customs of the States of
Ching and Chhu [i.e. of the districts cor-
responding to those ancient States;
Hupei, Hunan and Chiangsi].
Prob. Liang, c. +550, but perhaps partly
Sui, c. +610.
Tsung Lin 宗懷.
See des Rotours (1), p. cii.
- Ching-Shih Cheng Lei Pei-Chi Pên Tshao* 經史
證類備急本草.
The Classified and Consolidated Armament-
arium of Pharmaceutical Natural History.
Sung, +1083, repr. +1090.
Thang Shen-Wei 唐慎微.
- Ching Shih Thung Yen* 警世通言.
Stories to Warn Men.
Ming, c. +1640.
Fêng Mêng-Lung 馮夢龍.
- Ching Tien Shih Wen* 經典釋文.
Textual Criticism of the Classics.
Sui, c. +600.
Lu Tê-Ming 陸德明.
- Ching Yen Fang* 經驗方.
Tried and Tested Prescriptions.
Sung, +1025.
Chang Shêng-Tao 張聲道.
Now extant only in quotations.
- Ching Yen Liang Fang* 經驗良方.
Valuable Tried and Tested Prescriptions.
Yuan.
Writer unknown.
- Chiu Cheng Lu* 就正錄.
Drawing near to the Right Way; a Guide
[to physiological alchemy].
Ching, prefs. +1678, +1697.
Lu Shih-Chhen 陸世忱.
In *Tao Tsang Hsü Pien* (Chhu chi), 8.
- Chiu Chuan Chhing Chin Ling Sha Tan* 九轉青
金靈砂丹.
The Ninefold Cyclically Transformed
Caerulean Golden Numinous Cinnabar
Elixir.
Date unknown.
Writer unknown, but much overlap with
TT/886.
TT/887.
- Chiu Chuan Ling Sha Ta Tan* 九轉靈砂大
丹.

- Chiu Chuan Ling Sha Ta Tan (cont.)*
The Great Ninefold Cyclically Transformed
Numinous Cinnabar Elixir.
Date unknown.
Writer unknown.
TT/886.
- Chiu Chuan Ling Sha Ta Tan Tzu Sheng Hsüan*
Ching 九轉靈砂大丹資聖玄經.
Mysterious (or Esoteric) Sagehood-
Enhancing Canon of the Great Ninefold
Cyclically Transformed Numinous Cinna-
bar Elixir (or Enchymoma).
Date unknown, probably Thang; the text is
in sūtra form.
Writer unknown.
TT/879.
- Chiu Chuan Liu Chu Shen Hsien Chiu Tan Ching*
九轉流珠神仙九丹經.
Manual of the Nine Elixirs of the Holy
Immortals and of the Ninefold Cyclically
Transformed Mercury.
Not later than Sung, but contains material
from much earlier dates.
Thai-Chhing Chen Jen 太清真人.
TT/945.
- Chiu Huan Chin Tan Erh Chang* 九還金丹二章.
Two Chapters on the Ninefold Cyclically
Transformed Gold Elixir.
Alternative title of *Ta-Tung Lien Chen Pao*
Ching, *Chin Huan Chin Tan Miao Chieh*
(q.v.).
In YCCC, ch. 68, pp. 8a ff.
- Chiu Phu* 酒譜.
A Treatise on Wine.
Sung, +1020.
Tou Phing 饒苹.
- Chiu Shih* 酒史.
A History of Wine.
Ming, +16th (but first pr. +1750).
Feng Shih-Hua 馮時化.
- Chiu Thang Shu* 舊唐書.
Old History of the Thang Dynasty [+618
to +906].
Wu Tai (H/Chin), +945.
Liu Hsü 劉昫.
Cf. des Rotours (2), p. 64.
For translations of passages see the index of
Frankel (1).
- Chiu Ting Shen Tan Ching Chüeh*
See *Huang Ti Chiu Ting Shen Tan Ching*
Chüeh.
- Cho Keng Lu* 輟耕錄.
[Sometimes *Nan Tshun Cho Keng Lu*.]
Talks (at South Village) while the Plough is
Resting.
Yuan, +1366.
Thao Tsung-I 陶宗儀.
- Chou Hou Pei Chi Fang* 肘後備急方.
[= *Chou Hou Tsu Chiu Fang*
or *Chou Hou Pai I Fang*
or *Ko Hsien Ong Chou Hou Pei Chi Fang*.]
Handbook of Medicines for Emergencies.
Chin, c. +340.
Ko Hung 葛洪.
- Chou Hou Pai I Fang* 肘後百一方
See *Chou Hou Pei Chi Fang*.
- Chou Hou Tsu Chiu Fang* 肘後卒救方
See *Chou Hou Pei Chi Fang*.
- Chou I Tshan Thung Chhi* 周易參同契.
See also titles under *Tshan Thung Chhi*.
- Chou I Tshan Thung Chhi Chieh* 周易參同契解.
The Kinship of the Three and the Book of
Changes, with Explanation.
Text, H/Han, c. +140.
Comm., Sung, +1234.
Ed. & comm. Chhen Hsien-Wei 陳顯微.
TT/998.
- Chou I Tshan Thung Chhi Chu* 周易參同契註.
The Kinship of the Three and the Book of
Changes, with Commentary.
Text, H/Han, c. +140.
Comm. ascr. H/Han, c. +160, but prob-
ably Sung.
Attrib., ed. and comm. Yin Chhang-Sheng
陰長生.
TT/990.
- Chou I Tshan Thung Chhi Chu* 周易參同契註.
The Kinship of the Three and the Book of
Changes, with Commentary.
Text, H/Han, c. +140.
Comm. probably Sung.
Ed. and comm. unknown.
TT/991.
- Chou I Tshan Thung Chhi Chu* 周易參同契註.
The Kinship of the Three and the Book of
Changes, with Commentary.
Text, H/Han, c. +140.
Comm. probably Sung.
Ed. and comm. unknown.
TT/995.
- Chou I Tshan Thung Chhi Chu* 周易參同契註.
The Kinship of the Three and the Book of
Changes, with Commentary.
Text, H/Han, c. +140.
Comm., Sung, c. +1230.
Ed. & comm. Chhu Hua-Ku 儲華谷.
TT/999.
- Chou I Tshan Thung Chhi Chu* (TT/992).
Alternative title for *Tshan Thung Chhi*
Khao I (Chu Hsi's) q.v.
- Chou I Tshan Thung Chhi Fa Hui* 周易參同契
發揮.
Elucidations of the Kinship of the Three and
the Book of Changes [alchemy].
Text, H/Han, c. +140.
Comm., Yuan, +1284.
Ed. & comm. Yü Yen 俞琰.
Tr. Wu & Davis (1).
TT/996.
- Chou I Tshan Thung Chhi Fên Chang Chu* (Chieh)
周易參同契分章註(解).
The Kinship of the Three and the Book of
Changes divided into (short) chapters,
with Commentary and Analysis.

- Chou I Tshan Thung Chhi Fên Chang Chu (Chieh)*
(cont.)
Text, Han, c. +140.
Comm., Yuan, c. +1330.
Comm. Chên Chih-Hsü 陳致虛
(Shang Yang Tzu 上陽子).
TTCY pên 93.
- Chou I Tshan Thung Chhi Fên Chang Thung*
Chen I 周易參同契分章通真義.
The Kinship of the Three and the Book of
Changes divided into (short) chapters for
the Understanding of its Real Meanings.
Text, H/Han, c. +140.
Comm., Wu Tai +947.
Ed. & comm. Phêng Hsiao 彭曉.
Tr. Wu & Davis (1).
TT/993.
- Chou I Tshan Thung Chhi Shih I* 周易參同契
釋疑.
Clarification of Doubtful Matters in the
Kinship of the Three and the Book of
Changes.
Yuan, +1284.
Ed. & comm. Yü Yen 俞琰.
TT/997.
- Chou I Tshan Thung Chhi Su Lüeh* 周易參同
契疏略.
Brief Explanation of the Kinship of the Three
and the Book of Changes.
Ming, +1564.
Ed. & comm. Wang Wên-Lu 王文祿.
- Chou I Tshan Thung Chhi T'ing Chhi Ko Ming*
Ching Thu 易周參同契鼎器歌明鏡
圖.
An Illuminating Chart for the Mnemonic
Rhymes about Reaction-Vessels in the
Kinship of the Three and the Book of
Changes.
Text, H/Han, c. +140 (T'ing Chhi Ko
portion only).
Comm., Wu Tai, +947.
Ed. & comm. Phêng Hsiao 彭曉.
TT/994.
- Chu Chêng Pien I* 諸證辨疑.
Resolution of Diagnostic Doubts.
Ming, late +15th.
Wu Chhiu 吳球.
- Chu Chhüan Chi* 竹泉集.
The Bamboo Springs Collection [poems
and personal testimonies on physiological
alchemy].
Ming, +1465.
Tung Chhung-Li et al. 董重理.
In *Wai Chin Tan* (q.v.), ch. 3.
- Chu Chia Shen Phin Tan Fa* 諸家神品丹法.
Methods of the Various Schools for Magical
Elixir Preparations (an alchemical an-
thology).
Sung.
Mêng Yao-Fu 孟要甫
(Hsüan Chen Tzu 玄眞子) et al.
TT/911.
- Chu Fan Chih* 諸蕃志.
Records of Foreign Peoples (and their Trade).
Sung, c. +1225. (This is Pelliot's dating;
Hirth & Rockhill favoured between
+1242 and +1258.)
Chao Ju-Kua 趙汝适.
Tr. Hirth & Rockhill (1).
- Chu Yeh Thing Tsa Chi* 竹葉亭雜記.
Miscellaneous Records of the Bamboo Leaf
Pavilion.
Chhing, begun c. +1790 but not finished
till c. 1820.
Yao Yuan-Chih 姚元之.
- Chuan Hsi Wang Mu Wo Ku Fa* 傳西王母握
固法.
[= *Thai-Shang Chuan Hsi Wang Mu Wo
Ku Fa*.]
A Recording of the Method of Grasping
the Firmness (taught by) the Mother
Goddess of the West.
[Taoist heliotherapy and meditation. 'Grasp-
ing the firmness' was a technical term for
a way of clenching the hands during
meditation.]
Thang or earlier.
Writer unknown.
Fragment in *Hsiu Chen Shih Shu* (TT/260),
ch. 24, p. 1a ff.
Cf. Maspero (7), p. 376.
- Chuang Lou Chi* 妝樓記.
Records of the Ornamental Pavilion.
Wu Tai or Sung, c. +960.
Chang Mi 張泌.
- Chün-Chai Tu Shu Chih* 郡齋讀書志.
Memoir on the Authenticities of Ancient
Books, by (Chhao) Chün-Chai.
Sung, +1151.
Chhao Kung-Wu 晁公武.
- Chün-Chai Tu Shu Fu Chih* 郡齋讀書附志.
Supplement to Chün-Chai's (Chhao Kung-
Wu's) *Memoir on the Authenticities of
Ancient Books*.
Sung, c. +1200.
Chao Hsi-Pien 趙希弁.
- Chün-Chai Tu Shu Hou Chih* 郡齋讀書後志.
Further Supplement to Chün-Chai's (Chhao
Kung-Wu's) *Memoir on the Authenticities
of Ancient Books*.
Sung, pref. +1151, pr. +1250.
Chhao Kung-Wu 晁公武, re-compiled by
Chao Hsi-Pien 趙希弁, from the edi-
tion of Yao Ying-Chi 姚應績.
- Chün Phu* 菌譜.
A Treatise on Fungi.
Sung, +1245.
Chhen Jen-Yü 陳仁玉.
- Chung Hua Ku Chin Chu* 中華古今注.
Commentary on Things Old and New in
China.
Wu Tai (H/Thang), +923 to +926.
Ma Kao 馬縞.
See des Rotours (1), p. xcix.

- Chung Huang Chen Ching* 中黃真經
[= *Thai-Chhing Chung Huang Chen Ching*
or *Thai Tsang Lun*.]
True Manual of the Middle (Radiance) of
the Yellow (Courts), (central regions of the
three parts of the body) [Taoist anatomy
and physiology with Buddhist influence].
Prob. Sung, +12th or +13th.
Chiu Hsien Chün (ps.) 九仙君.
Comm. Chung Huang Chen Jen (ps). 中
黃真人.
TT/810.
Completing TT/328 and 329 (Wieger).
Cf. Maspero (7), p. 364.
- Chung Lü Chuan Tao Chi* 鍾呂傳道集.
Dialogue between Chungli (Chhüan) and
Lü (Tung-Pin) on the Transmission of
the Tao (and the Art of Longevity, by
Rejuvenation).
Thang, +8th or +9th.
Attrib. Chungli Chhüan 鍾離權 and Lü
Yen 呂岳.
Ed. Shih Chien-Wu 施肩吾.
In *Hsiu Chen Shih Shu* (TT/260), chs.14-16
incl.
- Chung Shan Yü Kuei Fu Chhi Ching* 中山玉
櫃服氣經.
Manual of the Absorption of the Chhi,
found in the Jade Casket on Chung-
Shan (Mtn). [Taoist breathing exercises.]
Thang or Sung, +9th or +10th.
Attrib. Chang Tao-Ling (Han) 張道陵 or
Pi-Yen Chang Tao-chê 碧嚴張道者
or Pi-Yen hsien-sêng 碧嚴先生.
Comm. by Huang Yuan-Chün 黃元君.
In YCCC, ch. 60, pp. 1 a ff.
Cf. Maspero (7), pp. 204, 215, 353.
- Chungli Pa Tuan Chin Fa* 鍾離八段錦法.
The Eight Elegant (Gymnastic) Exercises of
Chungli (Chhüan).
Thang, late +8th.
Chungli Chhüan 鍾離權.
In *Hsiu Chen Shih Shu* (TT/260), ch. 19.
Tr. Maspero (7), pp. 418 ff.
Cf. Notice by Tsêng Tshao in *Lin Chiang
Hsien* (TT/260, ch. 23, pp. 1 b, 2 a) dated
+1151. This says that the text was in-
scribed by Lü Tung-Pin himself on stone
and so handed down.
- Chhang Chhun Tzu Phan-Hsi Chi* 長春子磻溪
集.
Chhiu Chhang-Chhun's Collected (Poems)
at Phan-Hsi.
Sung, c. +1200.
Chhiu Chhu-Chi 邱處機.
TT/1145.
- Chhang Shêng Shu* 長生術.
The Art and Mystery of Longevity and
Immortality.
Alternative title of *Chin Hua Tsung Chih* (q.v.).
Chhen Wai Hsia Chü Chien 塵外遐舉踐.
Examples of Men who Renounced Official
Careers and Shook off the Dust of the
World [the eighth and last part (ch. 19)
of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高謙.
Chhi Chü An Lo Chien 起居安樂踐.
On (Health-giving) Rest and Recreations in
a Retired Abode [the third part (Chs. 7,
8) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高謙.
Chhi Fan Ling Sha Ko 七返靈砂歌.
Song of the Sevenfold Cyclically Trans-
formed Numinous Cinnabar (Elixir).
See *Chhi Fan Tan Sha Chüeh*.
Chhi Fan Ling Sha Lun 七返靈砂論.
On Numinous Cinnabar Seven Times
Cyclically Transformed.
Alternative title for *Ta-Tung Lien Chen Pao
Ching*, *Hsiu Fu Ling Sha Miao Chüeh*
(q.v.).
In YCCC, ch. 69, pp. 1 a ff.
Chhi Fan Tan Sha Chüeh 七返丹砂訣.
[= *Wei Po-Yang Chhi Fan Tan Sha Chüeh*
or *Chhi Fan Ling Sha Ko*.]
Explanation of the Sevenfold Cyclically
Transformed Cinnabar (Elixir), (of Wei
Po-Yang).
Date unknown (ascr. H/Han).
Writer unknown (attrib. Wei Po-Yang).
Comm. by Huang Thung-Chün 黃童君.
Thang or pre-Thang, before +806.
TT/881.
- Chhi Hsiao Liang Fang* 奇效良方.
Effective Therapeutics.
Ming, c. +1436, pr. +1470.
Fang Hsien 方賢.
Chhi Kuo Khao 七國考.
Investigations of the Seven (Warring) States.
Chhing, c. +1660.
Tung Yüeh 董說.
Chhi Lu 七錄.
Bibliography of the Seven Classes of Books.
Liang, +523.
Juan Hsiao-Hsü 阮孝緒.
Chhi Min Yao Shu 齊民要術.
Important Arts for the People's Welfare
[lit. Equality].
N/Wei (and E/Wei or W/Wei), between
+533 and +544.
Chia Ssu-Hsieh 賈思勰.
See des Rotours (1), p.c.; Shih Shêng-Han (1).
*Chhi Yün Shan Wu Yuan Tzu Hsiu Chen Pien
Nan* (Tshan Chêng) 棲雲山悟元子修
真辯難參證.
See *Hsiu Chen Pien Nan* (Tshan Chêng).
Chhieh Yün 切韻.
Dictionary of the Sounds of Characters
[rhyming dictionary].
Sui, +601.
Lu Fa-Yen 陸法言.
See *Kuang Yün*.

- Chhien Chin Fang Yen I* 千金方衍義.
Dilations upon the *Thousand Golden Remedies*.
Chhing, +1698.
Chang Lu 張璐.
- Chhien Chin I Fang* 千金翼方.
Supplement to the *Thousand Golden Remedies* [i.e. Revised Prescriptions saving lives worth a Thousand Ounces of Gold].
Thang, between +660 and +680.
Sun Ssu-Mo 孫思邈.
- Chhien Chin Shih Chih* 千金食治.
A Thousand Golden Rules for Nutrition and the Preservation of Health [i.e. Diet and Personal Hygiene saving lives worth a Thousand Ounces of Gold], (included as a chapter in the *Thousand Golden Remedies*).
Thang, +7th (c. +625, certainly before +659).
Sun Ssu-Mo 孫思邈.
- Chhien Chin Yao Fang* 千金要方.
A Thousand Golden Remedies [i.e. Essential Prescriptions saving lives worth a Thousand Ounces of Gold].
Thang, between +650 and +659.
Sun Ssu-Mo 孫思邈.
- Chhien Han Shu* 前漢書.
History of the Former Han Dynasty [-206 to +24].
H/Han (begun about +65), c. +100.
Pan Ku 班固, and (after his death in +92) his sister Pan Chao 班昭.
Partial trs. Dubs (2), Pfizmaier (32-34, 37-51), Wylie (2, 3, 10), Swann (1).
Yin-Tê Index, no. 36.
- Chhien Hung Chia Keng Chih Pao Chi Chheng* 鉛汞甲庚至寶集成.
Complete Compendium on the Perfected Treasure of Lead, Mercury, Wood and Metal [with illustrations of alchemical apparatus].
On the translation of this title, cf. Vol. 5, pt. 3. Has been considered Thang, +808; but perhaps more probably Wu Tai or Sung.
Cf. p. 276.
Chao Nai-An 趙耐菴.
TT/912.
- Chhien Khun Pi Yün* 乾坤秘韞.
The Hidden Casket of Chhien and Khun (kua, i.e. Yang and Yin) Open'd.
Ming, c. +1430.
Chu Chhüan 朱權.
(Ning Hsien Wang 寧獻王, prince of the Ming.)
- Chhien Khun Shêng I* 乾坤生意.
Principles of the Coming into Being of Chhien and Khun (kua, i.e. Yang and Yin).
Ming, c. +1430.
Chu Chhüan 朱權.
(Ning Hsien Wang 寧獻王, prince of the Ming.)
- Chhieh Shui Hsüan Chu* 赤水玄珠.
The Mysterious Pearl of the Red River [a system of medicine and iatro-chemistry].
Ming, +1596.
Sun I-Khuei 孫一奎.
- Chhieh Shui Hsüan Chu Chhüan Chi* 赤水玄珠全集.
The Mysterious Pearl of the Red River; a Complete (Medical) Collection.
See *Chhieh Shui Hsüan Chu*.
- Chhieh Shui Yin* 赤水吟.
Chants of the Red River.
See Fu Chin-Chhüan (1).
- Chhieh Sung Tzu Chou Hou Yao Chüeh* 赤松子肘後藥訣.
Oral Instructions of the Red-Pine Master on Handy (Macrobiotic) Prescriptions.
Pre-Thang.
Writer unknown.
Part of the *Thai-Chhing Ching Thien-Shih Khou Chüeh*.
TT/876.
- Chhieh Sung Tzu Hsüan Chi* 赤松子玄記.
Arcane Memorandum of the Red-Pine Master.
Thang or earlier, before +9th.
Writer unknown.
Quoted in TT/928 and elsewhere.
- Chhin Hsüan Fu* 摛玄賦.
Rhapsodical Ode on Grappling with the Mystery.
Sung, +13th.
Writer unknown.
TT/257.
- Chhing Hsiang Tsa Chi* 齊箱雜記.
Miscellaneous Records on Green Bamboo Tablets.
Sung, c. +1070.
Wu Chhu-Hou 吳處厚.
- Chhing Hsiu Miao Lun Chien* 清修妙論.
Subtle Discourses on the Unsullied Restoration (of the Primary Vitalities) [the first part (chs. 1, 2) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高麗.
- Chhing I Lu* 清異錄.
Records of the Unworldly and the Strange.
Wu Tai, c. +950.
Thao Ku 陶穀.
- Chhing-Ling Chen-jen Phei Chün (Nei) Chuan* 清靈真人裴君內傳.
Biography of the Chhing-Ling Adept, Master Phei.
L/Sung or S/Chhi, +5th, but with early Thang additions.
Têng Yün Tzu 鄧雲子.
(Phei Hsüan-Jen 裴玄仁 was a semi-legendary immortal said to have been born in -178).

- Ching-Ling Chen-Jen Phei Chün (Nei) Chuan* (cont.)
In YCCC, ch. 105.
Cf. Maspero (7), pp. 386 ff.
- Ching Po Tsa Chih* 清波雜志.
Green-Waves Memories.
Sung, +1193.
Chou Hui 周輝.
- Ching Wei Tan Chüeh* (or *Fa*) 清微丹訣 (法).
Instructions for Making the Enchymoma in Calmness and Purity [physiological alchemy].
Date unknown, perhaps Tang.
Writer unknown.
TT/275.
- Chhiu Chhang-Chhun Chhing Thien Ko* 邱長春青天歌.
Chhiu Chhang-Chhun's Song of the Blue Heavens.
Sung, c. +1200.
Chhiu Chhu-Chi 邱處機.
TT/134.
- Chhu Chheng I Shu* 褚澄遺書.
Remaining Writings of Chhu Chheng.
Chhi, c. +500, probably greatly remodelled in Sung.
Chhu Chheng 褚澄.
- Chhü Hsien Shen Yin Shu* 臞仙神隱書.
Book of Daily Occupations for Scholars in Rural Retirement, by the Emaciated Immortal.
Ming, c. +1430.
Chu Chhüan 朱權.
(Ning Hsien Wang 寧獻王, prince of the Ming.)
- Chhu Hsüeh Chi* 初學記.
Entry into Learning [encyclopaedia].
Tang, +700.
Hsü Chien 徐堅.
- Chhü I Shuo Tsuan* 祛疑說纂.
Discussions on the Dispersal of Doubts.
Sung, c. +1230.
Chhu Yung 儲泳.
- Chhüan-Chen Chi Hsüan Pi Yao* 全真集玄秘要.
Esoteric Essentials of the Mysteries (of the Tao), according to the Chhüan-Chen (Perfect Truth) School [the Northern School of Taoism in Sung and Yuan times].
Yuan, c. +1320.
Li Tao-Shun 李道純.
TT/248.
- Chhüan-Chen Tso Po Chieh Fa* 全真坐鉢捷法.
Ingenious Method of the Chhüan-Chen School for Timing Meditation (and other Exercises) by a (Sinking-) Bowl Clepsydra.
Sung or Yuan.
Writer unknown.
TT/1212.
- Chhüan Ching* 拳經.
Manual of Boxing.
Ching, +18th.
Chang Khung-Chao 張孔昭.
- Chhun Chhiu Fan Lu* 春秋繁露.
String of Pearls on the *Spring and Autumn Annals*.
C/Han, c. -135.
Tung Chung-Shu 董仲舒.
See Wu Khang (1).
Partial trs. Wieger (2); Hughes (1); d'Hormon (1) (ed.).
Chung-Fa Index no. 4.
- Chhun Chhiu Wei Yuan Ming Pao* 春秋緯元命苞.
Apocryphal Treatise on the *Spring and Autumn Annals*; the Mystical Diagrams of Cosmic Destiny [astrological-astronomical].
C/Han, c. -1st.
Writer unknown.
In *Ku Wei Shu*, ch. 7.
- Chhun Chhiu Wei Yün Tou Shu* 春秋緯運斗樞.
Apocryphal Treatise on the *Spring and Autumn Annals*; the Axis of the Turning of the Ladle (i.e. the Great Bear).
C/Han, -1st or later.
Writer unknown.
In *Ku Wei Shu*, ch. 9, pp. 4b ff. and YHSF, ch. 55, pp. 22a ff.
- Chhun Chu Chi Wên* 春渚紀聞.
Record of Things Heard at Spring Island.
Sung, c. +1095.
Ho Wei 何薏.
- Chhun-yang* etc.
See *Shun-yang*.
- Chhung-Hsiu Cheng-Ho Ching-Shih Cheng Lei* 重修政和經史證類備用本草.
New Revision of the Pharmacopoeia of the Cheng-Ho reign-period; the Classified and Consolidated Armamentarium.
(A Combination of the *Cheng-Ho*... *Cheng Lei*... *Pên Tshao* with the *Pên Tshao Yen I*.)
Yuan, +1249; reprinted many times afterwards, esp. in the Ming, +1468, with at least seven Ming editions, the last in +1624 or +1625.
Thang Shen-Wei 唐慎微.
Khou Tsung-Shih 寇宗奭.
Pr. (or ed.) Chang Tshun-Hui 張存惠.
- Chhung-Yang Chhüan Chen Chi* 重陽全真集.
(Wang) Chhung-Yang's [Wang Chê's] Records of the Perfect Truth (School).
Sung, mid +12th cent.
Wang Chê 王嘉.
TT/1139.
- Chhung-Yang Chiao Hua Chi* 重陽教化集.
Memorials of (Wang) Chhung-Yang's [Wang Chê's] Preaching.
Sung, mid +12th cent.
Wang Chê 王嘉.
TT/1140.
- Chhung-Yang Chin-Kuan Yü-So Chüeh* 重陽金闕玉鎖訣.

- Chhung-Yang Chin-Kuan Yü-So Chüeh* (cont.)
(Wang) Chhung-Yang's [Wang's Chê's]
Instructions on the Golden Gate and the
Lock of Jade.
Sung, mid + 12th cent.
Wang Chê 王翥.
TT/1142.
- Chhung-Yang Fên-Li Shih-Hua Chi* 重陽分梨
十化集.
Writings of (Wang) Chhung-Yang [Wang
Chê] (to commemorate the time when he
received a daily) Ration of Pears, and the
Ten Precepts of his Teacher.
Sung, mid + 12th cent.
Wang Chê 王翥.
TT/1141.
- Chhung-Yang Li-Chiao Shih-Wu Lun* 重陽立
教十五論.
Fifteen Discourses of (Wang) Chhung-
Yang [Wang Chê] on the Establishment
of his School.
Sung, mid + 12th cent.
Wang Chê 王翥.
TT/1216.
- Đai-Việt Su-ký Toàn-thú* 大越史記全書.
The Complete Book of the History of
Great Annam.
Vietnam, c. +1479.
Ngô Sĩ-Liên 吳士連.
- Fa Yen* 法言.
Admonitory Sayings [in admiration, and
imitation, of the *Lun Yü*].
Hsin, +5.
Yang Hsiung 揚雄.
Tr. von Zach (5).
- Fa Yuan Chu Lin* 法苑珠林.
Forest of Pearls from the Garden of the
[Buddhist] Law.
Thang, +668, +688.
Tao-Shih 道世.
- Fan Tzu Chi Yan* 范子計然.
See *Chi Ni Tzu*.
- Fang Hu Wai Shih* 方輿外史.
Unofficial History of the Land of the Im-
mortals, Fang-hu. (Contains two *nei tan*
commentaries on the *Tshan Thung Chhi*,
+1569 and +1573.)
Ming, c. +1590.
Lu Hsi-Hsing 陸西星.
Cf. Liu Tshun-Jen (1, 2).
- Fang Yü Chi* 方輿記.
General Geography.
Chin, or at least pre-Sung.
Hsü Chia 徐鉉.
- Fei Lu Hui Ta* 斐錄彙答.
Questions and Answers on Things Material
and Moral.
Ming, +1636.
Kao I-Chih (Alfonso Vagnoni) 高一志.
Bernard-Maitre (18), no. 272.

- Fên Thu* 粉圖.
See *Hu Kang Tzu Fên Thu*.
- Fêng Su Thung I* 風俗通義.
The Meaning of Popular Traditions and
Customs.
H/Han, +175.
Ying Shao 應劭.
Chung-Fa Index, no. 3.
- Fo Shuo Fo I Wang Ching* 佛說佛醫王經
Buddha Vaidyarāja Sūtra; or *Buddha-prokta
Buddha-bhaiṣajyarāja Sūtra* (Sūtra of the
Buddha of Healing, spoken by
Buddha).
India.
Tr. San Kuo (Wu) +230.
Trs. Liu Yen (Vinayāṭapa) & Chih-
Chhien. 支謙.
N/1327; TW/793.
- Fo Tzu Li Tai Thung Tsai* 佛祖歷代通載.
General Record of Buddhist and Secular
History through the Ages.
Yuan, +1341.
Nien-Chhang (monk) 念常.
Fu Chhi Ching I Lun 服氣精義論.
Dissertation on the Meaning of 'Absorbing
the Chhi and the Ching' (for Longevity
and Immortality), [Taoist hygienic, resp-
iratory, pharmaceutical, medical and
(originally) sexual procedures].
Thang, c. +715.
Ssuma Chhêng-Chên 司馬承貞.
In YCCC, ch. 57.
Cf. Maspero (7), pp. 364 ff.
- Fu Hung Thu* 伏承圖.
Illustrated Manual on the Subduing of
Mercury.
Sui, Thang, J/Chin or possibly Ming.
Shêng Hsüan Tzu 昇玄子.
Survives now only in quotations.
- Fu Nei Yuan Chhi Ching* 服內元氣經.
Manual of Absorbing the Internal Chhi of
Primary (Vitality).
Thang, +8th, probably c. +755.
Huan Chen hsien-sêng (Mr Truth-and-
Illusion) 幻真先生.
TT/821, and in YCCC, ch. 60, pp. 106 ff.
Cf. Maspero (7), p. 199.
- Fu Shih Lun* 服石論.
Treatise on the Consumption of Mineral
Drugs.
Thang, perhaps Sui.
Writer unknown.
Extant only in excerpts preserved in the
I Hsin Fang (+982).
- Fu Shou Tan Shu* 福壽丹書.
A Book of Elixir-Enchymoma Techniques
for Happiness and Longevity.
Ming, +1621.
Chêng Chih-Chhiao 鄭之喬 (at least in
part).
Partial tr. of the gymnastic material,
Dudgeon (1).

- Fusō Ryakuki* 扶桑略記.
Classified Historical Matters concerning the
Land of Fu-Sang (Japan) [from +898 to
+1197].
Japan (Kamakura) +1198.
Kōen (monk).
- Genji Monogatari* 源氏物語.
The Tale of (Prince) Genji.
Japan, +1021.
Murasaki Shikibu 紫式部.
- Hai Yao Pên Tshao* 海藥本草.
[= *Nan Hai Yao Phu*.]
Materia Medica of the Countries Beyond
the Seas.
Wu Tai (C/Shu), c. +923.
Li Hsün 李珣.
Preserved only in numerous quotations in
Chêng Lei Pên Tshao and later pandects.
- Han Fei Tzu* 韓非子.
The Book of Master Han Fei.
Chou, early - 3rd century.
Han Fei 韓非.
Tr. Liao Wên-Kuei (1).
- Han Kuan I* 漢官儀.
The Civil Service of the Han Dynasty and
its Regulations.
H/Han +197.
Ying Shao 應劭.
Ed. Chang Tsung-Yuan 張宗源 (+1752
to 1800).
Cf. Hummel (2), p. 57.
- Han Kung Hsiang Fang* 漢宮香方.
On the Blending of Perfumes in the Palaces
of the Han.
H/Han, +1st or +2nd.
Genuine parts preserved c. +1131 by
Chang Pang-Chi 張邦基.
Attrib. Tung Hsia-Chou 董道周.
Comm. by Chêng Hsüan 鄭玄.
'Restored', c. +1590, by Kao Lien 高麗.
- Han Thien Shih Shih Chia* 漢天師世家.
Genealogy of the Family of the Han
Heavenly Teacher.
Date uncertain.
Writers unknown.
With Pu Appendix, 1918, by Chang Yuan-
Hsü 張元旭 (the 62nd Taoist Patriarch,
Thien Shih).
TT/1442.
- Han Wei Tshung-Shu* 漢魏叢書.
Collection of Books of the Han and Wei Dyn-
asties [first only 38, later increased to
96].
Ming, +1592.
Ed. Thu Lung 屠隆.
- Han Wu (Ti) Ku Shih* 漢武(帝)故事.
Tales of (the Emperor) Wu of the Han
(r. -140 to -87).
L/Sung and Chhi, late +5th.
Wang Chien 王儉.
- Perhaps based on an earlier work of the
same kind by Ko Hung 葛洪.
Tr. d'Hormon (1).
- Han Wu (Ti) Nei Chuan* 漢武(帝)內傳.
The Inside Story of (Emperor) Wu of the
Han (r. -140 to -87).
Material of Chin, L/Sung, Chhi, Liang and
perhaps Chhen date, +320 to +580,
probably stabilised about +580.
Attrib. Pan Ku, Ko Hung, etc.
Actual writer unknown.
TT/289.
Tr. Schipper (1).
- Han Wu (Ti) Nei Chuan Fu Lu* 漢武(帝)內傳
附錄.
See *Han Wu (Ti) Wai Chuan*.
Han Wu (Ti) Wai Chuan 漢武(帝)外傳.
[= *Han Wu (Ti) Nei Chuan Fu Lu*.]
Extraordinary Particulars of (Emperor) Wu
of the Han (and his collaborators), [largely
biographies of the magician-technicians
at Han Wu Ti's court].
Material of partly earlier date collected and
stabilised in Sui or Thang, early +7th
century.
Writers and editor unknown.
Introductory paragraphs added by Wang
Yu-Yen 王游巖 (+746).
TT/290.
Cf. Maspero (7), p. 234, and Schipper (1).
- Hei Chhien Shui Hu Lun* 黑鉛水虎論.
Discourse on the Black Lead and the Water
Tiger.
Alternative title of *Huan Tan Nei Hsiang
Chin Yo Shih*, q.v.
- Ho Chi Chü Fang* 和劑局方.
Standard Formularies of the (Government)
Pharmacies [based on the *Thai-Phing
Shêng Hui Fang* and other collections].
Sung, c. +1109.
Ed. Chhen Chhêng 陳承, Phei Tsung-
Yuan 裴宗元, & Chhen Shih-Wên
陳師文.
Cf. SIC, p. 974.
- Honan Chhen Shih Hsiang Phu* 河南陳氏香譜.
See *Hsiang Phu* by Chhen Ching.
- Honan Chhêng Shih I Shu* 河南程氏遺書.
Remaining Records of Discourses of the
Chhêng brothers of Honan [Chhêng I and
Chhêng Hao, +11th-century Neo-
Confucian philosophers].
Sung, +1168, pr. c. +1250.
Chu Hsi (ed.) 朱熹.
In *Erh Chhêng Chhüan Shu*, q.v.
Cf. Graham (1), p. 141.
- Honan Chhêng Shih Tshui Yen* 河南程氏粹言.
Authentic Statements of the Chhêng brothers
of Honan [Chhêng I and Chhêng Hao,
+11th-century Neo-Confucian philo-
sophers. In fact more altered and abridged
than the other sources, which are therefore
to be preferred.]

Honan Chheng Shih Tshui Yen (cont.)

Sung, first collected c. +1150, supposedly
ed. +1166, in its present form by
c. +1340.

Coll. Hu Yin 胡寅.

Supposed ed. Chang Shih 張拭.

In *Erh Chheng Chhuan Shu*, q.v., since
+1606.

Cf. Graham (1), p. 145.

Honzō-Wamyō 本草和名.

Synonymic Materia Medica with Japanese
Equivalents.

Japan, +918.

Fukane no Sukehito 深根輔仁.

Cf. Karow (1).

Hou Han Shu 後漢書.

History of the Later Han Dynasty [+25 to
+220].

L/Sung, +450.

Fan Yeh 范曄.

The monograph chapters by Ssuma Piao

司馬彪 (d. +305), with commentary by
Liu Chao 劉昭 (c. +510), who first in-
corporated them in the work.

A few chs. tr. Chavannes (6, 16); Pfizmaier
(52, 53).

Yin-Tê Index, no. 41.

Hou Tê Lu 厚德錄.

Stories of Eminent Virtue.

Sung, early +12th.

Li Yuan-Kang 李元綱.

Hu Kang Tzu Fên Thu 狐剛子粉圖.

Illustrated Manual of Powders [Salts], by
the Fox-Hard Master.

Sui or Thang.

Hu Kang Tzu 狐剛子.

Survives now only in quotations; originally
in *TT* but lost. Cf. Vol. 4, pt. 1, p. 308.

Hua Tho Nei Chao Thu 佗佗內照圖.

Hua Tho's Illustrations of Visceral Anatomy.

See *Hsüan Mên Mo Chüeh Nei Chao Thu*.

Cf. Miyashita Saburo (1).

Hua-Yang Thao Yin-Chü Chuan 華陽陶隱居傳.

A Biography of Thao Yin-Chü (Thao
Hung-Ching) of Huayang [the great
alchemist, naturalist and physician].

Thang.

Chia Sung 賈嵩.

TT/297.

Hua Yen Ching 華嚴經.

Buddha-avatamsaka Sūtra; The Adorn-
ment of Buddha.

India.

Tr. into Chinese, +6th century.

TW/278, 279.

Huai Nan Hung Lieh Chieh 淮南鴻烈解.

See *Huai Nan Tzu*.

Huai Nan Tzu 淮南子.

[= *Huai Han Hung Lieh Chieh* 淮南鴻烈
解.]

The Book of (the Prince of) Huai-Nan
[compendium of natural philosophy].

C/Han, c. -120.

Written by the group of scholars gathered
by Liu An (prince of Huai-Nan) 劉安.

Partial trs. Morgan (1); Erkes (1); Hughes
(1); Chatley (1); Wieger (2).

Chung-Fa Index, no. 5.

TT/1170.

*Huai-Nan (Wang) Wan Pi Shu 淮南(王)萬畢
術.*

[Prob. = *Chen-Chung Hung-Pao Yuan-Pi
Shu* and variants.]

The Ten Thousand Infallible Arts of (the
Prince of) Huai-Nan [Taoist magical and
technical recipes].

C/Han, -2nd century.

No longer a separate book but fragments
contained in *TPYL*, ch. 736 and elsewhere.

Reconstituted texts by Yeh Tê-Hui in
Kuan Ku Thang So Chu Shu, and Sun
Fêng-I in *Wên Ching Thang Tshung-Shu*.

Attrib. Liu An 劉安.

See Kaltenmark (2), p. 32.

It is probable that the terms *Chen-Chung
枕中 Confidential Pillow-Book*; *Hung-
Pao 鴻寶 Infinite Treasure*; *Wan-Pi
萬畢 Ten Thousand Infallible*; and
Yuan-Pi 苑祕 Garden of Secrets; were
originally titles of parts of a *Huai-Nan
Wang Shu* 淮南王書 (Writings of the
Prince of Huai-Nan) forming the *Chung
Phien 中篇* (and perhaps also the
Wai Shu 外書) of which the present
Huai Nan Tzu book (q.v.) was the *Nei
Shu 內書*.

Huan Chen hsien-sêng, etc. 幻眞先生.

See *Thai Hsi Ching* and *Fu Nei Yuan Chhi
Ching*.

Huan Chin Shu 還金述.

An Account of the Regenerative Metallous
Enchymoma.

Thang, probably +9th.

Thao Chih 陶植.

TT/915, also excerpted, in *YCCC*, ch. 70,
pp. 13 a ff.

Huan Tan Chou Hou Chieh 還丹肘後訣.

Oral Instructions on Handy Formulae for
Cyclically Transformed Elixirs [with
illustrations of alchemical apparatus].

Ascr. Chin, c. +320.

Actually Thang, including a memorandum
of +875 by Wu Ta-Ling 仵達靈, and
the rest probably by other hands within a
few years of this date.

Attrib. Ko Hung 葛洪.

TT/908.

Huan Tan Chung Hsien Lun 還丹衆仙論.

Pronouncements of the Company of the
Immortals on Cyclically Transformed
Elixirs.

Sung, +1052.

Yang Tsai 楊在.

TT/230.

- Huan Tan Fu Ming Phien* 還丹復命篇.
Book on the Restoration of Life by the
Cyclically Transformed Elixir.
Sung, +12th cent., c. +1175.
Hsüeh Tao-Kuang 薛道光.
TT/1074.
- Huan Tan Nei Hsiang Chin Yo Shih* 還丹內象
金鑰匙.
[= *Hei Chhien Shui Hu Lun* and *Hung
Chhien Huo Lung Lun*.]
A Golden Key to the Physiological Aspects
of the Regenerative Enchymoma.
Wu Tai, c. +950.
Phêng Hsiao 彭曉.
Now but half a chapter in YCCC, ch. 70,
pp. 1a ff., though formerly contained in
the *Tao Tsang*.
- Huan Tan Pi Chüeh Yang Chhih-Tzu Shen
Fang* 還丹秘訣養赤子神方.
The Wondrous Art of Nourishing the
(Divine) Embryo (lit. the Naked Babe) by
the use of the secret Formula of the Re-
generative Enchymoma [physiological
alchemy].
Sung, probably late +12th.
Hsü Ming-Tao 許明道.
TT/229.
- Huan Yü Shih Mo* 寰宇始末.
On the Beginning and End of the World
[the Hebrew-Christian account of crea-
tion, the Four Aristotelian Causes,
Elements, etc.].
Ming, +1637.
Kao I-Chih (Alfonso Vagnoni) 高一志.
Bernard-Maitre (18), no. 283.
- Huan Yuan Phien* 還原篇.
Book of the Return to the Origin [poems on
the regaining of the primary vitalities in
physiological alchemy].
Sung, c. +1140.
Shih Thai 石泰.
TT/1077. Also in *Hsiu Chen Shih Shu*
(TT/260), ch. 2.
- Huang Chi Ching Shih Shu* 皇極經世書.
Book of the Sublime Principle which
governs All Things within the World.
Sung, c. +1060.
Shao Yung 邵雍.
TT/1028. Abridged in *Hsing Li Ta Chhuan*
and *Hsing Li Ching I*.
- Huang Chi Ho Pi Hsien Ching* 皇極圖關仙經.
[= *Yin Chen Jen Tung-Hua Cheng Mo Huang
Chi Ho Pi Cheng Tao Hsien Ching*.]
The Height of Perfection (attained by)
Opening and Closing (the Orifices of the
Body); a Manual of the Immortals [phys-
iological alchemy, *nei tan* techniques].
Ming or Chhing.
Attrib. Yin chen jen (Phêng-Thou)
尹真人 (蓬頭).
Ed. Min I-T'ê 閔一得, c. 1830.
In *Tao Tsang Hsü Pien* (*Chhu chü*), 2, from
a MS. preserved at the Blue Goat Temple
青羊宮 (Chhêngtu).
- Huang Pai Ching* 黃白鏡.
Mirror of (the Art of) the Yellow and the
White [physiological alchemy].
Ming, +1598.
Li Wen-Chu 李文燭.
Comm. Wang Chhing-Chêng 王清正.
In *Wai Chin Tan* coll., ch. 2 (CTPS, pên
7).
- Huang-Thien Shang-Chhing Chin Chhüeh Ti
Chün Ling Shu Tzu-Wên Shang Ching*
皇天上清金闕帝君靈書紫文上經.
Exalted Canon of the Imperial Lord of the
Golden Gates, Divinely Written in Purple
Script; a Huang-Thien Shang-Chhing
Scripture.
Chin, late +4th, with later revisions.
Writer unknown.
TT/634.
- Huang Thing Chung Ching Ching* 黃庭中景經.
[= *Thai-Shang Huang Thing Chung Ching
Ching*.]
Manual of the Middle Radiance of the
Yellow Courts (central regions of the
three parts of the body) [Taoist anatomy
and physiology].
Sui.
Li Chhien-Chhêng 李千乘.
TT/1382, completing TT/398-400.
Cf. Maspero (7), pp. 195, 203.
- Huang Thing Nei Ching Wu Tsang Liu Fu Fu
Hsieh Thu* 黃庭內景五臟六府補瀉圖
Diagrams of the Strengthening and Weaken-
ing of the Five Yin-viscera and the Six
Yang-viscera (in accordance with) the
(Jade Manual of the) Internal Radiance of
the Yellow Courts.
Thang, c. +850.
Hu An 胡愔.
TT/429.
- Huang Thing Nei Ching Wu Tsang Liu Fu Thu*
黃庭內景五臟六府圖.
Diagrams of the Five Yin-viscera and the
Six Yang-viscera (discussed in the *Jade
Manual of the) Internal Radiance of the
Yellow Courts* [Taoist anatomy and physi-
ology; no illustrations surviving, but much
therapy and pharmacy].
Thang, +848.
Hu An 胡愔 (title: *Thai-pai Shan Chien
Su Nü*) 太白山見素女.
In *Hsiu Chen Shih Shu* (TT/260), ch. 54.
Illustrations preserved only in Japan, MS. of
before +985.
SIC, p. 223; Watanabe Kozo (1), pp. 112 ff.
- Huang Thing Nei Ching Yü Ching* 黃庭內景
玉經.
[= *Thai-Shang Huang Thing Nei Ching Yü
Ching*.]
Jade Manual of the Internal Radiance of the
Yellow Courts (central regions of the

- Huang Thing Nei Ching Yü Ching* (cont.)
three parts of the body) [Taoist anatomy and physiology]. In 36 *chang*.
L/Sung, Chhi, Liang or Chhen, +5th or +6th. The oldest parts date probably from Chin, about +365.
Writer unknown. Allegedly transmitted by immortals to the Lady Wei (Wei Fu Jen), i.e. Wei Hua-Tshun 魏華存.
TT/328.
Paraphrase by Liu Chhang-Shêng 劉長生 (Sui), TT/398.
Comms. by Liang Chhiu Tzu 梁丘子 (Thang), TT/399, and Chiang Shen-Hsiu 蔣愼修 (Sung), TT/400.
Cf. Maspero (7), p. 239.
- Huang Thing Nei Ching Yü Ching Chu* 黃庭內景玉經註.
Commentary on (and paraphrased text of) the *Jade Manual of the Internal Radiance of the Yellow Courts*.
Sui.
Liu Chhang-Shêng 劉長生.
TT/398.
- Huang Thing Nei Ching (Yü) Ching Chu* 黃庭內景(玉)經註.
Commentary on the *Jade Manual of the Internal Radiance of the Yellow Courts*.
Thang, +8th or +9th.
Liang Chhiu Tzu (ps.) 梁丘子.
TT/399, and in *Hsiu Chen Shih Shu* (TT/260), chs. 55-57; and in YCCC, chs. 11, 12 (where the first 3 *chang* (30 verses) have the otherwise lost commentary of Wu Chhêng Tzu 務成子).
Cf. Maspero (7), pp. 239 ff.
- Huang Thing Nei Wai Ching Yü Ching Chieh* 黃庭內外景玉經解.
Explanation of the *Jade Manuals of the Internal and External Radiances of the Yellow Courts*.
Sung.
Chiang Shen-Hsiu 蔣愼修.
TT/400.
- Huang Thing Wai Ching Yü Ching* 黃庭外景玉經.
[= *Thai-Shang Huang Thing Wai Ching Yü Ching*.]
Jade Manual of the External Radiance of the Yellow Courts (central regions of the three parts of the body) [Taoist anatomy and physiology]. In 3 *chüan*.
H/Han, San Kuo or Chin, +2nd or +3rd. Not later than +300.
Writer unknown.
TT/329.
Comms. by Wu Chhêng Tzu 務成子 (early Thang) YCCC, ch. 12; Liang Chhiu Tzu 梁丘子 (late Thang), TT/260, chs. 58-60; Chiang Shen-Hsiu 蔣愼修 (Sung), TT/400.
Cf. Maspero (7), pp. 195 ff., 428 ff.
- Huang Thing Wai Ching Yü Ching Chu* 黃庭外景玉經註.
Commentary on the *Jade Manual of the External Radiance of the Yellow Courts*.
Sui or early Thang, +7th.
Wu Chhêng Tzu (ps.) 務成子.
In YCCC, ch. 12, pp. 30a ff.
Cf. Maspero (7), p. 239.
- Huang Thing Wai Ching Yü Ching Chu* 黃庭外景玉經註.
Commentary on the *Jade Manual of the External Radiance of the Yellow Courts*.
Thang, +8th or +9th.
Liang Chhiu Tzu (ps.) 梁丘子.
In *Hsiu Chen Shih Shu* (TT/260), chs. 58-60.
Cf. Maspero (7), pp. 239 ff.
- Huang Ti Chiu T'ing Shen Tan Ching Chüeh* 黃帝九鼎神丹經訣.
The Yellow Emperor's Canon of the Nine-Vessel Spiritual Elixir, with Explanations. Early Thang or early Sung, but incorporating as ch. 1 a canonical work probably of the +2nd cent.
Writer unknown.
TT/878. Also, abridged, in YCCC, ch. 67, pp. 1a ff.
- Huang Ti Nei Ching, Ling Shu* 黃帝內經靈樞.
The Yellow Emperor's Manual of Corporeal (Medicine), the Vital Axis [medical physiology and anatomy].
Probably C/Han, c. -1st century.
Writers unknown.
Edited Thang, +762, by Wang Ping 王冰. Analysis by Huang Wên (1).
Tr. Chamfrault & Ung Kang-Sam (1).
Commentaries by Ma Shih 馬蒔 (Ming) and Chang Chih-Tshung 張志聰 (Chhing) in TSCC, *I shu tien*, chs. 67 to 88.
- Huang Ti Nei Ching, Ling Shu, Pai Hua Chieh* See Chhen Pi-Liu & Chêng Cho-Jen (1).
- Huang Ti Nei Ching, Su Wên* 黃帝內經素問.
The Yellow Emperor's Manual of Corporeal (Medicine); Questions (and Answers) about Living Matter [clinical medicine].
Chou, remodelled in Chhin and Han, reaching final form c. -2nd century.
Writers unknown.
Ed. & comm., Thang (+762), Wang Ping 王冰; Sung (c. +1050), Lin I 林億. Partial trs. Hübotter (1), chs. 4, 5, 10, 11, 21; Veith (1); complete, Chamfrault & Ung Kang-Sam (1).
See Wang & Wu (1), pp. 28 ff.; Huang Wên (1).
- Huang Ti Nei Ching Su Wên I Phien* 黃帝內經素問遺篇.
The Missing Chapters from the *Questions and Answers of the Yellow Emperor's Manual of Corporeal (Medicine)*.
Ascr. pre-Han.
Sung, preface, +1099.

- Huang Ti Nei Ching Su Wen I Phien (cont.)*
Ed. (perhaps written by) Liu Wen-Shu
劉溫舒.
Often appended to his *Su Wen Ju Shih Yün Chhi Ao Lun* (q.v.) 素問入式運氣奧論.
- Huang Ti Nei Ching Su Wen, Pai Hua Chieh*
See Chou Feng-Wu, Wang Wan-Chieh & Hsü Kuo-Chhien (1).
- Huang Ti Pa-shih-i Nan Ching Tsuan Thu Chü Chieh* 黃帝八十一難經纂圖句解.
Diagrams and a Running Commentary for the *Manual of (Explanations Concerning) Eighty-one Difficult (Passages) in the Yellow Emperor's (Manual of Corporeal Medicine)*.
Sung, +1270 (text H/Han, +1st).
Li Kung 李嗣.
TT/1012.
- Huang Ti Pao Tsang Ching* 黃帝寶藏經.
Perhaps an alternative name for *Hsien-Yuan Pao Tsang (Chhang Wei) Lun*, q.v.
- Huang Ti Yin Fu Ching* 黃帝陰符經.
See *Yin Fu Ching*.
- Huang Ti Yin Fu Ching Chu* 黃帝陰符經註.
Commentary on the *Yellow Emperor's Book on the Harmony of the Seen and the Unseen*.
Sung.
Liu Chhu-Hsüan 劉處玄.
TT/119.
- Huang Yeh Fu* 黃治賦.
Rhapsodic Ode on 'Smelting the Yellow' [alchemy].
Thang, c. +840.
Li Tê-Yü 李德裕.
In *Li Wen-yao Pieh Chi*, ch. 1.
- Huang Yeh Lun* 黃治論.
Essay on the 'Smelting of the Yellow' [alchemy].
Thang, c. +830.
Li Tê-Yü 李德裕.
In *Wen Yuan Ying Hua*, ch. 739, p. 15a, and *Li Wen-yao Wai Chi*, ch. 4.
- Hui Ming Ching* 慧命經.
[= *Tsui-Shang I Chheng Hui Ming Ching*, also entitled *Hsü Ming Fang*.]
Manual of the (Achievement of) Wisdom and the (Lengthening of the) Life-Span.
Chhing, +1794.
Liu Hua-Yang 柳華陽.
Cf. Wilhelm & Jung (1), editions after 1957.
- Hung Chhien Huo Lung Lun* 紅鉛火龍論.
Discourse on the Red Lead and the Fire Dragon.
Alternative title of *Huan Tan Nei Hsiang Chin Yo Shih*, q.v.
- Hung Chhien Yu Hei Chhien Chüeh* 紅鉛入黑鉛訣.
Oral Instructions on the Entry of the Red Lead into the Black Lead.
Probably Sung, but some of the material perhaps older.
Compiler unknown.
TT/934.
- Huo Kung Chhieh Yao* 火攻挈要.
Essentials of Gunnery.
Ming, +1643.
Chiao Hsü 焦勗.
With the collaboration of Thang Jo-Wang (J. A. Schall von Bell) 湯若望.
Bernard-Maitre (18), no. 334.
- Huo Lien Ching* 火蓮經.
Manual of the Lotus of Fire [physiological alchemy].
Ming or Chhing.
Attrib. Liu An, 劉安 (Han).
In *Wai Chin Tan*, coll., ch. 1 (CTPS, pên 6).
- Huo Lung Ching* 火龍經.
The Fire-Drake (Artillery) Manual.
Ming, +1412.
Chiao Yü 焦玉.
The first part of this book, in three sections, is attributed fancifully to Chuko Wu-Hou (i.e. Chuko Liang), and Liu Chi 劉基 (+1311 to +1375) appears as co-editor, really perhaps co-author.
The second part, also in three sections, is attributed to Liu Chi alone, but edited, probably written, by Mac Hsi-Ping 毛希秉 in +1632.
The third part, in two sections, is by Mao Yuan-I 毛元儀 (fl. +1628) and edited by Chuko Kuang-Jung 諸葛光榮 whose preface is of +1644, Fang Yuan-Chuang 方元壯 & Chung Fu-Wu 鍾伏武.
- Huo Lung Chüeh* 火龍訣.
Oral Instructions on the Fiery Dragon [proto-chemical and physiological alchemy].
Date uncertain, ascr. Yuan, +14th.
Attrib. Shang Yang Tsu Shih 上陽祖師.
In *Wai Chin Tan* (coll.), ch. 3 (CTPS, pên 8).
- Hupei Thung Chih* 湖北通志.
Historical Geography of Hupei Province.
Min Kuo, 1921, but based on much older records.
See Yang Chheng-Hsi (ed.) (1) 楊承禧.
- Hsi Chhi Tshung Hua* 西溪叢話.
(SKCS has *Yü* 語).
Western Pool Collected Remarks.
Sung, c. +1150.
Yao Khuan 姚寬.
- Hsi Chhing Ku Chien* 西清古鑑.
Hsi Chhing Catalogue of Ancient Mirrors (and Bronzes) in the Imperial Collection.
(The collection was housed in the Library of Western Serenity, a building in the southern part of the Imperial Palace).
Chhing, +1751.
Liang Shih-Chheng 梁詩正.
- Hsi Shan Chhum Hsien Hui Chen Chi* 西山羣仙會真記.
A True Account of the Proceedings of the Company of Immortals in the Western Mountains.
Thang, c. +800.
Shih Chien-Wu 施肩吾.
TT/243.

- Hsi Shang Fu Than* 席上腐談.
Old-Fashioned Table Talk.
Yuan, c. +1290.
Yü Yen 俞琰.
- Hsi Wang Mu Nü Hsiu Chêng Thu Shih Tsê*
西王母女修正途十則.
The Ten Rules of the Mother (Goddess)
Queen of the West to Guide Women
(Taoists) along the Right Road of
Restoring (the Primary Vitalities) [phy-
siological alchemy].
Ming or Chhing.
Attrib. Lü Yen 呂岳 (+8th century).
Shen I-Ping et al. 沈一炳.
Comm. Min I-Tê 閔一得 (c. 1830).
In *Tao Tsang Hsi Pien (Chhu chi)*, 19.
- Hsi-Yang Huo Kung Thu Shuo* 西洋火攻圖說.
Illustrated Treatise on European Gunnery.
Ming, before +1625.
Chang Tao 張燾 & Sun Hsüeh-Shih
孫學詩.
- Hsi Yo Hua-Shan Chih* 西嶽華山誌.
Records of Hua-Shan, the Great Western
Mountain.
Sung, c. +1170.
Wang Chhu-I 王處一.
TT/304.
- Hsi Yo Tou hsien-sêng Hsiu Chen Chih Nan*
西嶽靈先生修真指南.
Teacher Tou's South-Pointer for the
Regeneration of the Primary (Vitalities),
from the Western Sacred Mountain.
Sung, probably early +13th.
Tou hsien-sêng 靈先生.
In *Hsiu Chen Shih Shu* (TT/260), ch. 21,
pp. 1a to 6b.
- Hsi Yu Chi* 西遊記.
A Pilgrimage to the West [novel].
Ming, c. +1570.
Wu Chhêng-ên 吳承恩.
Tr. Waley (17).
- Hsi Yu Chi*.
See *Chhang-Chhun Chen Yen Hsi Yu Chi*.
- Hsi Yü Chiu Wên* 西域舊聞.
Old Traditions of the Western Countries [a
conflation, with abbreviations, of the
Hsi Yü Wên Chien Lu and the *Shêng Wu
Chi*, q.v.].
Chhing, +1777 and 1842.
Chhun Yuan Chhi-shih-i Lao-jen 椿園七
十一老人 & Wei Yuan 魏源.
Arr. Chêng Kuang-Tsu (1843) 鄭光祖.
- Hsi Yü Thu Chi* 西域圖記.
Illustrated Record of Western Countries.
Sui, +610.
Phei Chü 裴矩.
- Hsi Yü Wên Chien Lu* 西域聞見錄.
Things Seen and Heard in the Western
Countries.
Chhing, +1777.
Chhun Yuan Chhi-shih-i Lao-jen
椿園七十一老人.
[The 71-year-old Gentleman of the Cedar
Garden.]
Bretschneider (2), vol. 1, p. 128.
- Hsi Yuan Lu* 洗冤錄.
The Washing Away of Wrongs (i.e. False
Charges) [treatise on forensic medicine].
Sung, +1247.
Sung Tzhu 宋慈.
Partial tr., H. A. Giles (7).
- Hsiang Chhêng* 香乘.
Records of Perfumes and Incense [in-
cluding combustion-clocks].
Ming, betw. +1618 and +1641.
Chou Chia-Chou 周嘉胄.
- Hsiang Chien* 香箋.
Notes on Perfumes and Incense.
Ming, c. +1560.
Thu Lung 屠隆.
- Huang Kuo* 香國.
The Realm of Incense and Perfumes.
Ming.
Mao Chin, 毛晉.
- Hsiang Lu* 香錄.
[= *Nan Fan Hsiang Lu*.]
A Catalogue of Incense.
Sung, +1151.
Yeh Thing-Kuei 葉廷珪.
- Hsiang Phu* 香譜.
A Treatise on Aromatics and Incense
[-Clocks].
Sung, c. +1073.
Shen Li 沈立.
Now extant only in the form of quotations
in later works.
- Hsiang Phu* 香譜.
A Treatise on Perfumes and Incense.
Sung, c. +1115.
Hung Chhu 洪鉞.
- Hsiang Phu* 香譜.
[= *Hsin Tsuan Hsiang Phu*
or *Honan Chhen shih Hsiang Phu*.]
A Treatise on Perfumes and Aromatic Sub-
stances [including incense and combust-
ion-clocks].
Sung, late +12th or +13th; may be as late
as +1330.
Chhen Ching 陳敬.
- Hsiang Phu* 香譜.
A Treatise on Incense and Perfumes.
Yuan, +1322.
Hsiung Phêng-Lai 熊朋來.
- Hsiang Yao Chhao* 香藥抄.
Memoir on Aromatic Plants and Incense.
Japan, shortly before +1156.
Kuan-Yu (Ken-i) 觀祐. MS. preserved at
the 滋賀石山寺 Temple. Facsim. re-
prod. in Suppl. to the Japanese Tripitaka,
vol. 11.
- Hsieh Thien Chi* 泄天機.
A Divulgence of the Machinery of Nature
(in the Human Body, permitting the
Formation of the Enchymoma).

- Hsieh Thien Chi* (cont.)
 Chhing, c. +1795.
 Li Ong (Ni-Wan shih) 李翁 (Mr Ni-Wan).
 Written down in 1833 by Min Hsiao-Kên
 閔小艮.
 In *Tao Tsang Hsü Pien* (Chhu chi), 4.
Hsien Lo Chi 仙樂集.
 (Collected Poems) on the Happiness of the
 Holy Immortals.
 Sung, late +12th cent.
 Liu Chhu-Hsüan 劉處玄.
 TT/1127.
Hsien-Yuan Huang Ti Shui Ching Yao Fa 軒轅
 黃帝水經藥法.
 (Thirty-two) Medicinal Methods from the
 Aqueous (Solutions) Manual of Hsien-
 Yuan the Yellow Emperor.
 Date uncertain.
 Writer unknown.
 TT/922.
Hsien-Yuan Pao Tsang Chhang Wei Lun 軒轅
 寶藏暢微論.
 The Yellow Emperor's Expansive yet
 Detailed Discourse on the (Contents of
 the) Precious Treasury (of the Earth)
 [mineralogy and metallurgy].
 Alternative title of *Pao Tsang Lun*, q.v.
Hsien-Yuan Pao Tsang Lun 軒轅寶藏論.
 The Yellow Emperor's Discourse on the
 Contents of the Precious Treasury (of the
 Earth).
 See *Pao Tsang Lun*.
Hsin Hsiu Pên Tshao 新修本草.
 The New (lit. Newly Improved) Pharma-
 copoeia.
 Thang, +659.
 Ed. Su Ching (= Su Kung) 蘇敬 (蘇恭)
 and a commission of 22 collaborators
 under the direction first of Li Chi 李勣
 & Yü Chih-Ning 于志寧, then of
 Chhangsun Wu-Chi 長孫無忌. This
 work was afterwards commonly but in-
 correctly known as *Thang Pên Tshao*. It
 was lost in China, apart from MS. frag-
 ments at Tunhuang, but copied by a
 Japanese in +731 and preserved in Japan
 though incompletely.
Hsin Lun 新論.
 New Discussions.
 H/Han, c. +10 to +20, presented +25.
 Huan Than 桓譚.
 Cf. Pokora (9).
Hsin Lun 新論.
 New Discourses.
 Liang, c. +530.
 Liu Hsieh 劉勰.
Hsin Thang Shu 新唐書.
 New History of the Thang Dynasty
 [+618 to +906].
 Sung, +1061.
 Ouyang Hsiu 歐陽修 & Sung Chhi
 宋祁.
 Cf. des Rotours (2), p. 56.
 Partial trs. des Rotours (1, 2); Pfizmaier (66-
 74). For translations of passages see the
 index of Frankel (1).
 Yin-Tê Index, no. 16.
Hsin Tsuan Hsiang Phu 新纂香譜.
 See *Hsiang Phu* by Chhen Ching.
Hsin Wu Tai Shih 新五代史.
 New History of the Five Dynasties [+907
 to +959].
 Sung, c. +1070.
 Ouyang Hsiu 歐陽修.
 For translations of passages see the index of
 Frankel (1).
Hsin Yü 新語.
 New Discourses.
 C/Han, c. -196.
 Lu Chia 陸賈.
 Tr. v. Gabain (1).
Hsing Li Ching I 性理精義.
 Essential Ideas of the Hsing-Li (Neo-
 Confucian) School of Philosophers [a con-
 densation of the *Hsing Li Ta Chhüan*, q.v.].
 Chhing, +1715.
 Li Kuang-Ti 李光地.
Hsing Li Ta Chhüan (Shu) 性理大全 (書).
 Collected Works of (120) Philosophers of
 the Hsing-Li (Neo-Confucian) School
 [*Hsing* = human nature; *Li* = the
 principle of organisation in all Nature].
 Ming, +1415.
 Ed. Hu Kuang *et al.* 胡廣.
Hsing Ming Kuei Chih 性命圭旨.
 A Pointer to the Meaning of (Human)
 Nature and the Life-Span [physiological
 alchemy; the *kuei* is a pun on the two
 kinds of *thu*, central earth where the
 enchymoma is formed].
 Ascr. Sung, pr. Ming and Chhing, +1615,
 repr. +1670.
 Attrib. Yin Chen Jen 尹真.
 Written out by Kao Ti 高第.
 Prefs. by Yü Yung-Ning *et al.* 余永寧.
Hsing Shih Hêng Yen 醒世恆言.
 Stories to Awaken Men.
 Ming, c. +1640.
 Fêng Méng-Lung 馮夢龍.
Hsiu Chen Chih Nan 修真指南.
 South-Pointer for the Regeneration of the
 Primary (Vitalities).
 See *Hsi Yo Tou hsien-sêng Hsiu Chen Chih*
Nan.
Hsiu Chen Li Yen Chhao Thu 修真歷驗鈔圖.
 [= *Chen Yuan Miao Tao Hsiu Tan Li Yen*
Chhao.]
 Transmitted Diagrams illustrating Tried and
 Tested (Methods of) Regenerating the
 Primary Vitalities [physiological alchemy].
 Thang or Sung, before +1019.
 No writer named but the version in YCCC,
 ch. 72, has Tung Chen Tzu (ps.) 洞真子.
 TT/149.

Hsiu Chen Nei Lien Pi Miao Chu Chüeh 修真內煉秘妙諸訣.

Collected Instructions on the Esoteric Mysteries of Regenerating the Primary (Vitalities) by Internal Transmutation.

Sung or pre-Sung.

Writer unknown.

Perhaps identical with *Hsiu Chen Pi Chüeh* (q.v.); now extant only in quotations.

Hsiu Chen Pi Chüeh 修真秘訣.

Esoteric Instructions on the Regeneration of the Primary (Vitalities).

Sung or pre-Sung, before +1136.

Writer uncertain.

In *Lei Shuo*, ch. 49, pp. 5a ff.

Hsiu Chen Pien Nan (Tshan Chêng) 修真辯難參證.

[*Chhi Yün Shan Wu Yuan Yzu Hsiu Chen Pien Nan Tshan Chêng*.]

A Discussion of the Difficulties encountered in the Regeneration of the Primary (Vitalities) [physiological alchemy]; with Supporting Evidence.

Chhing, +1798.

Liu I-Ming 劉一明 (Wu Yuan Tzu 悟元子).

Comm., Min I-Tê 閔一得 (c. 1830).

In *Tao Tsang Hsü Pien (Chhu chü)*, 23.

Hsiu Chen Shih Shu 修真十書.

A Collection of Ten Tractates and Treatises on the Regeneration of the Primary (Vitalities) [in fact, many more than ten].

Sung, c. +1250.

Editor unknown.

TT/260.

Cf. Maspero (7), pp. 239, 357.

Hsiu Chen Thai Chi Hun Yuan Thu 修真太極混元圖.

Illustrated Treatise on the (Analogy of the) Regeneration of the Primary (Vitalities) (with the Cosmogony of) the Supreme Pole and Primitive Chaos.

Sung, c. +1100.

Hsiao Tao-Tshun 蕭道存.

TT/146.

Hsiu Chen Thai Chi Hun Yuan Chih Hsüan Thu 修真太極混元指玄圖.

Illustrated Treatise Expounding the Mystery of the (Analogy of the) Regeneration of the Primary (Vitalities) (with the Cosmogony of) the Supreme Pole and Primitive Chaos.

Thang, c. +830.

Chin Chhüan Tzu 金全子.

TT/147.

Hsiu Chen Yen I 修真演義.

A Popular Exposition of (the Methods of) Regenerating the Primary (Vitalities) [Taoist sexual techniques].

Ming, c. +1560.

Têng Hsi-Hsien 鄧希賢 (Tzu Chin

Kuang Yao Ta Hsien 紫金光耀大仙).

See van Gulik (3, 8).

Hsiu Hsien Pien Huo Lun 修仙辨惑論.

Resolution of Doubts concerning the Restoration to Immortality.

Sung, c. +1220.

Ko Chhang-Kêng 葛長庚 (Pai Yü-Chhan 白玉蟾).

In *TSCC, Shen i tien*, ch. 300, *i wên*, pp. 11a ff.

Hsiu Lien Ta Tan Yao Chih 修鍊大丹要旨.

Essential Instructions for the Preparation of the Great Elixir [with illustrations of alchemical apparatus].

Probably Sung or later.

Writer unknown.

TT/905.

Hsiu Tan Miao Yung Chih Li Lun 修丹妙用至理論.

A Discussion of the Marvellous Functions and Perfect Principles of the Practice of the Enchymoma.

Late Sung or later.

Writer unknown.

TT/231.

Refers to the Sung adept Hai-Chhan hsien-sêng 海蟾先生 (Liu Tshao 劉操).

Hsü Chen-Chün Pa-shih-wu Hua Lu 許真君

入十五化錄.

Record of the Transfiguration of the Adept Hsü (Hsün) at the Age of Eighty-five.

Chin, +4th cent.

Shih Tshên 施岑.

TT/445.

Hsü Chen-Chün Shih Han Chi 許真君石函記.

The Adept Hsü (Hsün's) Treatise, found in a Stone Coffin.

Ascr. Chin, +4th cent., perhaps c. +370.

Attrib. Hsü Hsün 許遜.

TT/944.

Cf. Davis & Chao Yün-Tshung (6).

Hsü Hsien Chuan 續仙傳.

Further Biographies of the Immortals.

Wu Tai (H/Chou), between +923 and +936.

Shen Fên 沈汾.

In *YCCC*, ch. 113.

Hsü Ku Chai Chi Suan Fa 續古摘奇算法.

Choice Mathematical Remains Collected to Preserve the Achievements of Old [magic squares and other computational examples].

Sung, +1275.

Yang Hui 楊輝.

(In *Yang Hui Suan Fa*.)

Hsü Kuang-Chhi Shou Chi 徐光啓手跡.

Manuscript Remains of Hsü Kuang-Chhi [facsimile reproductions].

Shanghai, 1962.

Hsü Ming Fang 續命方.

Precepts for Lengthening the Life-span.

Alternative title of *Hui Ming Ching* (q.v.).

- Hsü Po Wu Chih* 續博物志.
Supplement to the *Record of the Investigation of Things* (cf. *Po Wu Chih*).
Sung, mid +12th century.
Li Shih 李石.
- Hsü Shen Hsien Chuan* 續神仙傳.
Supplementary Lives of the Hsien (cf. *Shen Hsien Chuan*).
Thang.
Shen Fên 沈汾.
- Hsü Shih Shih* 續事始.
Supplement to the *Beginnings of All Affairs* (cf. *Shih Shih*).
H/Shu, c. +960.
Ma Chien 馬鑑.
- Hsü Yen-Chou Shih Hua* 許彥周詩話.
Hsü Yen-Chou's Talks on Poetry.
Sung, early +12th, prob. c. +1111.
Hsü Yen-Chou 許彥周.
- Hsüan Chieh Lu* 懸解錄.
See *Hsüan Chieh Lu* 玄解錄.
- Hsüan Chieh Lu* 玄解錄.
The Mysterious Antidotarium [warnings against elixir poisoning, and remedies for it].
Thang, anonymous preface of +855, prob. first pr. between +847 and +850.
Writer unknown, perhaps Hokan Chi 紇干裏.
The first printed book in any civilisation on a scientific subject.
TT/921, and in YCCC, ch. 64, pp. 5a ff.
- Hsüan Fêng Chhing Hui Lu* 玄風慶會錄.
Record of the Auspicious Meeting of the Mysterious Winds [answers given by Chhiu Chhu-Chi (Chhang-Chhun Chen Jen) to Chingiz Khan at their interviews at Samarqand in +1222].
Sung, +1225.
Chhiu Chhu-Chi 邱處機.
TT/173.
- Hsüan-Ho Po Ku Thu Lu* 宣和博古圖錄.
[= *Po Ku Thu Lu*.]
Hsüan-Ho reign-period Illustrated Record of Ancient Objects [catalogue of the archaeological museum of the emperor Hui Tsung].
Sung, +1111 to +1125.
Wang Fu 王黼 or 黻 et al.
- Hsüan Kuai Hsü Lu* 玄怪續錄.
The *Record of Things Dark and Strange*, continued.
Thang.
Li Fu-Yen 李復言.
- Hsüan Mén Mo Chieh Nei Chao Thu* 玄門脈訣內照圖.
[= *Hua Tho Nei Chao Thu*.]
Illustrations of Visceral Anatomy, for the Taoist *Sphygmological Instructions*.
Sung, +1095, repr. +1273 by Sun Huan 孫煥 with the inclusion of Yang Chieh's illustrations.
- Attrib. Hua Tho 華佗.
First pub. Shen Chu 沈鍊.
Cf. Ma Chi-Hsing (2).
- Hsüan Ming Fên Chuan* 玄明粉傳.
On the 'Mysterious Bright Powder' (purified sodium sulphate, Glauber's salt).
Thang, c. +730.
Liu Hsüan-Chen 劉玄真.
- Hsüan Nü Ching* 玄女經.
Canon of the Mysterious Girl [or, the Dark Girl].
Han.
Writer unknown.
Only as fragment in *Shuang Mei Ching An Tshung Shu*, now conflated with *Su Nü Ching*, q.v.
Partial trs., van Gulik (3, 8).
- Hsüan Phin Lu* 玄品錄.
Record of the (Different) Grades of Immortals.
Yuan.
Chang Thien-Yü 張天雨.
TT/773.
Cf. Chhen Kuo-Fu (1), 1st ed., p. 260.
- Hsüan Shih Chih* 宣室志.
Records of Hsüan Shih.
Thang, c. +860.
Chang Tu 張讀.
- Hsüan Shuang Chang Shang Lu* 玄霜掌上錄.
Mysterious Frost on the Palm of the Hand; or, Handy Record of the Mysterious Frost [preparation of lead acetate].
Date unknown.
Writer unknown.
TT/938.
- I Chen Thang Ching Yen Fang* 頤真堂經驗方.
Tried and Tested Prescriptions of the True-Centenarian Hall (a surgery or pharmacy).
Ming, prob. +15th, c. +1450.
Yang shih 楊氏.
- I Chi Khao* 醫籍考.
Comprehensive Annotated Bibliography of Chinese Medical Literature.
See Taki Mototane (1).
- I Chai Ta Fa* 醫家大法.
See *I Yin Thang I Chung Ching Kuang Wei Ta Fa*.
- I Chien Chih* 夷堅志.
Strange Stories from I-Chien.
Sung, c. +1185.
Hung Mai 洪邁.
- I Chin Ching* 易筋經.
Manual of Exercising the Muscles and Tendons [Buddhist].
Ascr. N/Wei.
Chhing, perhaps +17th.
Attrib. Ta-Mo (Bodhidharma) 達摩.
Author unknown.
Reproduced in Wang Tsu-Yuan (1).

- I Ching* 易經.
The Classic of Changes [Book of Changes].
Chou with C/Han additions.
Compilers unknown.
See Li Ching-Chih (1, 2); Wu Shih-Chhang (1).
Tr. R. Wilhelm (2); Legge (9); de Harlez (1).
Yin-Tê Index, no. (suppl.) 10.
- I Hsin Fang* (Ishinhô) 醫心方.
The Heart of Medicine [partly a collection of ancient Chinese and Japanese books].
Japan, +982 (not printed till 1854).
Tamba no Yasuyori 丹波康賴.
- I Hsüeh Ju Mên* 醫學入門.
Janua Medicinæ [a general system of medicine].
Ming, +1575.
Li Chhan 李梴.
- I Hsüeh Yuan Liu Lun* 醫學源流論.
On the Origins and Progress of Medical Science.
Chhing, +1757.
Hsü Ta-Chhun 徐大椿.
(In *Hsü Ling-Thai I Shu Chhüan Chi*.)
- I Mên Pi Chih* 醫門秘旨.
Confidential Guide to Medicine.
Ming, +1578.
Chang Ssu-Wei 張四維.
- I Shan Tsa Tsuan* 義山難纂.
Collected Miscellany of (Li) I-Shan [Li Shang-Yin, epigrams].
Thang, c. +850.
Li Shang-Yin 李商隱.
Tr. Bonmarchand (1).
- I Shih* 逸史.
Leisurely Histories.
Thang.
Lu Shih 盧氏.
- I Su Chi* 夷俗記.
Records of Barbarian Customs.
Alternative title of *Pei Lu Feng Su*, q.v.
- I Thu Ming Pien* 易圖明辨.
Clarification of the Diagrams in the (*Book of*) *Changes* [historical analysis].
Chhing, +1706.
Hu Wei 胡渭.
- I Wei Chhien Tso Tu* 易緯乾鑿度.
Apocryphal Treatise on the (*Book of*) *Changes*; a Penetration of the Regularities of Chhien (the first *kua*).
C/Han, -1st or +1st century.
Writer unknown.
- I Wei Ho Thu Shu* 易緯河圖數.
Apocryphal Treatise on the (*Book of*) *Changes*; the Numbers of the Ho Thu (Diagram).
H/Han.
Writer unknown.
- I Yin Thang I Chung Ching Kuang Wei Ta Fa*
伊尹湯液仲景廣爲大法.
[= *I Chia Ta Fa* or *Kuang Wei Ta Fa*.]
The Great Tradition (of Internal Medicine) going back to I Yin (legendary minister) and his Pharmacal Potions, and to (Chang) Chung-Ching (famous Han physician).
Yuan, +1294.
Wang Hao-Ku 王好古.
ICK, p. 863.
- Ishinhô*
See *I Hsin Fang*.
- Jih Chih Lu* 日知錄.
Daily Additions to Knowledge.
Chhing, +1673.
Ku Yen-Wu 顧炎武.
- Jih Hua Chu Chia Pên Tshao* 日華諸家本草.
The Sun-Rays Master's Pharmaceutical Natural History, collected from Many Authorities.
Wu Tai and Sung, c. +972.
Often ascribed by later writers to the Thang, but the correct dating was recognised by Thao Tsung-I in his *Cho Kêng Lu* (+1366) ch. 24, p. 17b.
Ta Ming 大明.
(*Jih Hua Tzu* 日華子 the Sun-Rays Master.)
(Perhaps Thien Ta-Ming 田大明).
- Jih Yüeh Hsüan Shu Lun* 日月玄樞論.
Discourse on the Mysterious Axis of the Sun and Moon [i.e. Yang and Yin in natural phenomena; the earliest interpretation (or recognition) of the *Chou I Tshan Thung Chhi* (q.v.) as a physiological rather than (or, as well as) a proto-chemical text].
Thang, c. +740.
Liu Chih-Ku 劉知古.
Now extant only as quotations in the *Tao Shu* (q.v.), though at one time contained in the *Tao Tsang* separately.
- Ju Yao Ching* 入藥鏡.
Mirror of the All-Penetrating Medicine (the enchyronema), [rhyming verses].
Wu Tai, c. +940.
Tshui Hsi-Fan 崔希範.
TT/132, and in *TTCY* (*hsü chi*, 5).
With commentaries by Wang Tao-Yuan 王道淵 (Yuan); Li Phan-Lung 李攀龍 (Ming) & Phêng Hao-Ku 彭好古 (Ming).
Also in *Hsü Chen Shih Shu* (TT/260), ch. 13, pp. 1 a ff. with commentary by Hsiao Thing-Chih 蕭廷芝 (Ming).
Also in *Tao Hai Chin Liang*, pp. 35 a ff., with comm. by Fu Chin-Chhüan 傅金銓 (Chhing).
See also *Thien Yuan Ju Yao Ching*.
Cf. van Gulik (8), pp. 224 ff.
- Kan Chhi Shih-liu Chuan Chin Tan* 感氣十六轉金丹.
The Sixteen-fold Cyclically Transformed Gold Elixir prepared by the 'Responding

- Kan Chhi Shih-liu Chuan Chin Tan* (cont.)
to the Chhi' Method [with illustrations of alchemical apparatus].
Sung.
Writer unknown.
TT/904.
- Kan Ying Ching* 感應經.
On Stimulus and Response (the Resonance of Phenomena in Nature).
Thang, c. +640.
Li-Shun-Feng 李淳風.
See Ho & Needham (2).
- Kan Ying Lei Tshung Chih* 感應類從志.
Record of the Mutual Resonances of Things according to their Categories.
Chin, c. +295.
Chang Hua 張華.
See Ho & Needham (2).
- Kao Shih Chuan* 高士傳.
Lives of Men of Lofty Attainments.
Chin, c. +275.
Huangfu Mi 皇甫謐.
- Keng Hsin Yü Tshê* 庚辛玉冊.
Precious Secrets of the Realm of Keng and Hsin (i.e. all things connected with metals and minerals, symbolised by these two cyclical characters) [on alchemy and pharmaceuticals. Keng-Hsin is also an alchemical synonym for gold].
Ming, +1421.
Chu Chhüan 朱權. (Ning Hsien Wang 寧獻王, prince of the Ming).
Extant only in quotations.
- Keng Tao Chi* 庚道集.
Collection of Procedures of the Golden Art (Alchemy).
Sung or Yuan, date unknown but after +1144.
Writers unknown.
Compiler, Meng Hsien chü shih 蒙軒居士.
TT/946.
- Khai-Pao Hsin Hsiang-Ting Pên Tshao* 開寶新詳定本草.
New and More Detailed Pharmacopoeia of the Khai-Pao reign-period.
Sung, +973.
Liu Han 劉翰, Ma Chih 馬志, and 7 other naturalists, under the direction of Lu To-Hsün 盧多遜.
- Khai-Pao Pên Tshao* 開寶本草.
See *Khai-Pao Hsin Hsiang-Ting Pên Tshao*.
- Khun Yü Ko Chih* 坤輿格致.
Investigation of the Earth [Western mining methods based on Agricola's *De Re Metallica*].
Ming, +1639 to 1640, perhaps never printed.
Teng Yü-Han (Johann Schreck) 鄧玉函 & (or) Thang Jo-Wang 湯若望 (John Adam Schall von Bell).
- Khung Chi Ko Chih* 空際格致.
A Treatise on the Material Composition of the Universe [the Aristotelian Four Elements, etc.].
Ming, +1633.
Kao I-Chih (Alfonso Vagnoni) 高一志.
Bernard-Maitre (18), no. 227.
- Khung shih Tsa Shuo* 孔氏雜說.
Mr Khung's Miscellany.
Sung, c. +1082.
Khung Phing-Chung 孔平仲.
- Ko Chih Ching Yuan* 格致鏡原.
Mirror of Scientific and Technological Origins.
Chhing, +1735.
Chhen Yuan-Lung 陳元龍.
- Ko Chih Tshao* 格致草.
Scientific Sketches [astronomy and cosmology; part of *Han Yü Thung*, q.v.].
Ming, +1620, pr. +1648.
Hsiung Ming-Yü 熊明遇.
- Ko Hsien Ong Chou Hou Pei Chi Fang* 葛仙翁肘後備急方.
The Elder-Immortal Ko (Hung's) Handbook of Medicines for Emergencies.
Alt. title of *Chou Hou Pei Chi Fang* (q.v.).
TT/1287.
- Ko Hung Chen Chung Shu* 葛洪枕中書.
Alt. title of *Chen Chung Chi* (q.v.).
- Ko Ku Yao Lun* 格古要論.
Handbook of Archaeology, Art and Antiquarianism.
Ming, +1387, enlarged and reissued +1459.
Tshao Chao 曹昭.
- Ko Wu Tshu Than* 格物叢談.
Simple Discourses on the Investigation of Things.
Sung, c. +980.
Attrib. wrongly to Su Tung-Pho 蘇東坡. Actual writer (Lu) Tsan-Ning (錄) 贊寧 (Tung-Pho hsien-sêng). With later additions, some concerning Su Tung-Pho.
- Konjaku Monogatari* 今昔物語.
Tales of Today and Long Ago (in three collections: Indian, 187 stories and traditions, Chinese, 180, and Japanese, 736).
Japan (Heian), +1107.
Compilers unknown.
Cf. Anon. (103), pp. 97 ff.
- Konjaku Monogatari* 今昔物語集.
See *Konjaku Monogatari*.
- Ku Chin I Thung* (Ta Chhüan) 古今醫統 (大全).
Complete System of Medical Practice, New and Old.
Ming, +1556.
Hsü Chhun-Fu 徐春甫.
- Ku Thung Thu Lu* 鼓銅圖錄.
Illustrated Account of the (Mining), Smelting and Refining of Copper (and other Non-Ferrous Metals).
See Masuda Tsuna (1).
- Ku Wei Shu* 古微書.
Old Mysterious Books [a collection of the apocryphal Chhan-Wei treatises].
Date uncertain, in part C/Han.
Ed. Sun Chio 孫覈 (Ming).

- Ku Wên Lung Hu Ching Chu Su* 古文龍虎經註疏 and *Ku Wên Lung Hu Shang Ching Chu* 古文龍虎上經註.
See *Lung Hu Shang Ching Chu*.
Ku Wên Tshan Thung Chhi Chi Chieh 古文參同契集解.
See *Ku Wên Chou I Tshan Thung Chhi Chu*.
Ku Wên Tshan Thung Chhi Chien Chu Chi Chieh 古文參同契箋註集解.
See *Ku Wên Chou I Tshan Thung Chhi Chu*.
Ku Wên Chou I Tshan Thung Chhi Chu 古文周易參同契註.
Commentary on the Ancient Script Version of the *Kinship of the Three*.
Chhing, +1732.
Ed. and comm. Yuan Jen-Lin 袁仁林.
See Vol. 5, pt. 3.
Ku Wên Tshan Thung Chhi San Hsiang Lei Chi Chieh 古文參同契三相類集解.
See *Ku Wên Chou I Tshan Thung Chhi Chu*.
Kuan Khuei Pien 管窺編.
An Optick Glass (for the Enchymoma).
See Min I-Tê (1).
Kuan Yin Tzu 關尹子.
[= *Wên Shih Chen Ching*.]
The Book of Master Kuan Yin.
Thang, +742 (may be Later Thang or Wu Tai). A work with this title existed in the Han, but the text is lost.
Prob. Thien Thung-Hsiu 田同秀.
Kuang Chhêng Chi 廣成集.
The Kuang-chhêng Collection [Taoist writings of every kind; a florilegium].
Thang, late +9th; or early Wu Tai, before +933.
Tu Kuang-Thing 杜光庭.
TT/611.
Kuang Wei Ta Fa 廣爲大法.
See *I Yin Thang I Chung Ching Kuang Wei Ta Fa*.
Kuang Ya 廣雅.
Enlargement of the *Erh Ya*; *Literary Expositor* [dictionary].
San Kuo (Wei) +230.
Chang I 張揖.
Kuang Yün 廣韻.
Enlargement of the *Chhieh Yün*; *Dictionary of the Sounds of Characters*.
Sung.
(A completion by later Thang and Sung scholars, given its present name in +1011.)
Lu Fa-Yen et al. 陸法言.
Kuei Chung Chih Nan 規中指南.
A Compass for the Internal Compasses; or, Orientations concerning the Rules and Measures of the Inner (World) [i.e. the preparation of the enchymoma in the microcosm of man's body].
Sung or Yuan, +13th or +14th.
Chhen Chhung-Su 陳沖素 (Hsü Pai Tzu 盧白子).
TT/240, and in *TTCY* (*shang mao chi*, 5).
Kungyang Chuan 公羊傳.
Master Kungyang's Tradition (or Commentary) on the *Spring and Autumn Annals*.
Chou (with Chhin and Han additions), late -3rd and early -2nd centuries.
Attrib. Kungyang Kao 公羊高 but more probably Kungyang Shou 公羊壽.
See Wu Khang (1); van der Loon (1).
Kuo Shih Pu 國史補.
Emendations to the National Histories.
Thang, c. +820.
Li Chao 李肇.
Kuo Yü 國語.
Discourses of the (ancient feudal) States.
Late Chou, Chhin and C/Han, containing much material from ancient written records.
Writers unknown.
Lao Hsüeh An Pi Chi 老學庵筆記.
Notes from the Hall of Learned Old Age.
Sung, c. +1190.
Lu Yu 陸游.
Lao Tzu Chung Ching 老子中經.
The Median Canon of Lao Tzu [on physiological micro-cosmography].
Writer unknown.
Pre-Thang.
In *YCCC*, ch. 18.
Lao Tzu Shuo Wu Chhu Ching 老子說五廚經.
Canon of the Five Kitchens [the five viscera] Revealed by Lao Tzu [respiratory techniques].
Thang or pre-Thang.
Writer unknown.
In *YCCC*, ch. 61, pp. 5b ff.
Lei Chen Chin Tan 雷震金丹.
Lei Chen's Book of the Metallous Enchymoma.
Ming, after +1420.
Lei Chen (ps. ?) 雷震.
In *Wai Chin Tan*, ch. 5 (CTPS, pên 10).
Lei Chen Tan Ching 雷震丹經.
Alternative title of *Lei Chen Chin Tan* (q.v.).
Lei Chêng Phu Chi Pên Shih Fang 類證普濟本事方.
Classified Fundamental Prescriptions of Universal Benefit.
Sung, +1253.
Attrib. Hsü Shu-Wei 許叔微 (fl. +1132).
Lei Ching Fu I 類經附翼.
Supplement to the Classics Classified; (the Institutes of Medicine).
Ming, +1624.
Chang Chieh-Pin 張介賓.
Lei Kung Phao Chih 雷公炮製.
(Handbook based on the)Venerable Master Lei's (Treatise on) the Preparation (of Drugs).
L/Sung, c. +470.

- Lei Kung Phao Chi (cont.)*
 Lei Hsiao 雷嚴.
 Ed. Chang Kuang-Tou 張光斗 (Chhing), 1871.
- Lei Kung Phao Chih Lun* 雷公炮炙論.
 The Venerable Master Lei's Treatise on the Decoction and Preparation (of Drugs).
 L/Sung, c. +470.
 Lei Hsiao 雷嚴.
 Preserved only in quotations in *Cheng Lei Pên Tshao* and elsewhere, and reconstituted by Chang Chi 張騏.
 LPC, p. 116.
- Lei Kung Phao Chih Yao Hsing (Fu) Chieh* 雷公炮製藥性(賦)解.
 (Essays and) Studies on the Venerable Master Lei's (Treatise on) the Natures of Drugs and their Preparation.
 First four chapters J/Chin, c. +1220.
 Li Kao 李杲.
 Last six chapters Chhing, c. 1650.
 Li Chung-Tzu 李中梓.
 (Contains many quotations from earlier Lei Kung books, +5th century onwards.)
- Lei Kung Yao Tui* 雷公藥對.
 Answers of the Venerable Master Lei (to Questions) concerning Drugs.
 Perhaps L/Sung, at any rate before N/Chhi.
 Attrib. Lei Hsiao 雷嚴.
 Later attrib. a legendary minister of Huang Ti.
 Comm. by Hsü Chih-Tshai 徐之才, N/Chhi +565.
 Now extant only in quotations.
- Lei Shuo* 類說.
 A Classified Commonplace-Book [a great florilegium of excerpts from Sung and pre-Sung books, many of which are otherwise lost].
 Sung, +1136.
 Ed. Tsêng Tshao 曾慥.
- Li Chi* 禮記.
 [= *Hsiao Tai Li Chi*.]
 Record of Rites [compiled by Tai the Younger].
 (Cf. *Ta Tai Li Chi*).
 Ascr. C/Han, c. -70/-50, but really H/Han, between +80 and +105, though the earliest pieces included may date from the time of the *Analekts* (c. -465 to -450).
 Attrib. ed. Tai Shêng 戴聖.
 Actual ed. Tshao Pao 曹褒.
 Trs. Legge (7); Couvreur (3); R. Wilhelm (6).
 Yin-Tê Index, no. 27.
- Li Hai Chi* 螽蟴集.
 The Beetle and the Sea [title taken from the proverb that the beetle's eye view cannot encompass the wide sea—a biological book].
 Ming, late +14th century.
 Wang Khuei 王埜.
- Li Sao* 離騷.
 Elegy on Encountering Sorrow [ode].
 Chou (Chhu), c. -295, perhaps just before -300. Some scholars place it as late as -269.
 Chhü Yuan 屈原.
 Tr. Hawkes (1).
- Li Shih Chen Hsien Thi Tao Thung Chien* 歷世眞仙體道通鑑.
 Comprehensive Mirror of the Embodiment of the Tao by Adepts and Immortals throughout History.
 Prob. Yuan.
 Chao Tao-I 趙道一.
 TT/293.
- Li Tai Ming I Meng Chhiu* 歷代名醫蒙求.
 Brief Lives of the Famous Physicians in All Ages.
 Sung, +1040.
 Chou Shou-Chung 周守忠.
- (Li Tai) Shen Hsien (Thung) Chien* (歷代)神仙(通)鑑.
 (Cf. *Shen Hsien Thung Chien*).
 General Survey of the Lives of the Holy Immortals (in all Ages).
 Chhing, +1712.
 Hsü Tao 徐道 (assisted by Li Li 李理) & Chhêng Yü-Chhi 程毓奇 (assisted by Wang Thai-Su 王太素).
- Li Wei Tou Wei I* 禮緯斗威儀.
 Apocryphal Treatise on the Record of Rites; System of the Majesty of the Ladle [the Great Bear].
 C/Han, -1st or later.
 Writer unknown.
- Li Wên-jao Chi* 李文饒集.
 Collected Literary Works of Li Tê-Yü (Wên-jao), (+787 to +849).
 Thang, c. +855.
 Li Tê-Yü 李德裕.
- Liang Chhiu Tzu (Nei or Wai)* 梁丘子.
 See *Huang Thing Nei Ching (Yü) Ching Chu* and *Huang Thing Wai Ching (Yü) Ching Chu*.
- Liang Ssu Kung Chi* 梁四公記.
 Tales of the Four Lords of Liang.
 Thang, c. +695.
 Chang Yüeh 張說.
- Liao Yang Tien Wên Ta Pien* 廖陽殿問答編.
 [= *Yin Chen Jen Liao Yang Tien Wên Ta Pien*.]
 Questions and Answers in the (Eastern Cloister of the) Liao-yang Hall (of the White Clouds Temple at Chhing-chhêng Shan in Szechuan) [on physiological alchemy, *nei tan*].
 Ming or Chhing.
 Attrib. Yin Chen Jen 尹眞人 (Phêng-Thou 蓬頭).
 Ed. Min I-Tê 閔一得, c. 1830.
 In *Tao Tsang Hsü Pien (Chhu chi)*, 3, from a MS. preserved at the Blue Goat Temple 青羊宮 (Chhêngtu).

- Lieh Hsien Chhuan* 列仙全傳.
Complete Collection of the Biographies of the Immortals.
Ming, c. +1580.
Wang Shih-Chên 王世貞.
Collated and corrected by Wang Yün-Pêng 汪雲鵬.
- Lieh Hsien Chuan* 列仙傳.
Lives of Famous Immortals (cf. *Shen Hsien Chuan*).
Chin, +3rd or +4th century, though certain parts date from about -35 and shortly after +167.
Attrib. Liu Hsiang 劉向.
Tr. Kaltenmark (2).
- Lin Chiang Hsien* 臨江仙.
The Immortal of Lin-chiang.
Sung, +1151.
Tsêng Tshao 曾慥.
In *Hsiu Chen Shih Shu* (TT/260), ch. 23, pp. 1a ff.
- Ling-Pao Chiu Yu Chhang Yeh Chhi Shih Tu Wang Hsian Chang* 靈寶九幽長夜起尸度亡玄章.
Mysterious Cantrap for the Resurrection of the Body and Salvation from Nothingness during the Long Night in the Nine Underworlds; a Ling-Pao Scripture.
Date uncertain.
Writer unknown.
TT/605.
- Ling-Pao Chung Chen Tan Chüeh* 靈寶衆眞丹訣.
Supplementary Elixir Instructions of the Company of the Realised Immortals, a Ling-Pao Scripture.
Sung, after +1101.
Writer unknown.
TT/416.
On the term Ling-Pao see Kaltenmark (4).
- Ling-Pao Wu Fu* (Hsü) 靈寶五符(序).
See *Thai-Shang Ling-Pao Wu Fu* (Ching).
- Ling-Pao Wu Liang Tu Yen Shang Phin Miao Ching* 靈寶無量度人上品妙經.
Wonderful Immeasurable Highly Exalted Manual of Salvation; a Ling-Pao Scripture.
Liu Chhao, perhaps late +5th, probably finalised in Thang, +7th.
Writers unknown.
TT/1.
- Ling Pi Tan Yao Chien* 靈秘丹藥詮.
On Numinous and Secret Elixirs and Medicines [the seventh part (chs. 16-18) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高濂.
- Ling Piao Lu I* 嶺表錄異.
Strange Things Noted in the South.
Thang, c. +890.
Liu Hsün 劉恂.
- Ling Sha Ta Tan Pi Chüeh* 靈砂大丹秘訣.
Secret Doctrine of the Numinous Cinnabar and the Great Elixir.
Sung, after +1101, when the text was received by Chang Shih-Chung 張侍中.
Writer unknown, but edited by a Chhan abbot Kuei-Yen Chhan-shih 鬼眼禪師.
TT/890.
- Ling Shu Ching*
See *Huang Ti Nei Ching, Ling Shu*.
- Ling Wai Tai Ta* 嶺外代客.
Information on What is Beyond the Passes (lit. a book in lieu of individual replies to questions from friends).
Sung, +1178.
Chou Chhü-Fei 周法非.
- Liu Shu Ching Yün* 六書精蘊.
Collected Essentials of the Six Scripts.
Ming, c. +1530.
Wei Hsiao 魏校.
- Liu Tzu Hsin Lun* 劉子新論.
See *Hsin Lun*.
- Lo-Fou Shan Chih* 羅浮山志.
History and Topography of the Lo-fou Mountains (north of Canton).
Chhing, +1716 (but based on older histories).
Thao Ching-I 陶敬益.
- Lu Hsing Ching* 顓頊經.
A Tractate on the Fontanelles of the Skull [anatomical-medical].
Late Thang or early Sung, +9th or +10th.
Writer unknown.
- Lu Huo Chien Chieh Lu* 爐火監戒錄.
Warnings against Inadvisable Practices in the Work of the Stove [alchemical].
Sung, c. +1285.
Yü Yen 俞琰.
- Lu Huo Pên Tshao* 爐火本草.
Spagyric Natural History.
Possible alternative title of *Wai Tan Pên Tshao* (q.v.).
- Lü Tsu Chhin Yuan Chhun* 呂祖沁園春.
The (Taoist) Patriarch Lü (Yen's) 'Spring in the Prince's Gardens' [a brief epigrammatic text on physiological alchemy].
Thang, +8th (if genuine).
Attrib. Lü Yen 呂岳.
TT/133.
Comm. by Fu Chin-Chhuan 傅金鉉 (c. 1822).
In *Tao Hai Chin Liang*, p. 45a, and appended to *Shih Chin Shih* (Wu Chen Su Chu Phien ed.).
- Lü Tsu Chhuan Shou Tsung Chih* 呂祖傳授宗旨.
Principles (of Macrobiotics) Transmitted and Handed Down by the (Taoist) Patriarch Lü (Yen, Tung-Pin).
Orig. title of *Chin Hua Tsung Chih* (q.v.).

- Lü Tsu Shih Hsien-Thien Hsü Wu Thai-I Chin Hua Tsung Chih* 呂祖師先天虛無太一金華宗旨.
Principles of the (Inner) Radiance of the Metallous (Enchymoma) (explained in terms of the) Undifferentiated Universe, and of all the All-Embracing Potentiality of the Endowment of Primary Vitality, taught by the (Taoist) Patriarch Lü (Yen, Tung-Pin).
Alternative name for *Chin Hua Tsung Chih* (q.v.), but with considerable textual divergences, especially in ch. 1.
Ming and Chhing.
Writers unknown.
Attrib. Lü Yen 呂岳 (Lü Tung-Pin) and his school, late +8th.
Ed. and comm. Chiang Yuan-Thing 蔣元庭 and Min I-Tê 閔一得, c. 1830.
In *TTC Y* and in *Tao Tsang Hsü Pien* (*Chhu chi*), 1.
Lü Tsu Shih San Ni I Shih Shuo Shu 呂祖師三尼醫世說述.
A Record of the Lecture by the (Taoist) Patriarch Lü (Yen, Tung-Pin) on the Healing of Humanity by the Three Ni Doctrines (Taoism, Confucianism and Buddhism) [physiological alchemy in mutationist terms].
Chhing, +1664.
Attrib. Lü Yen 呂岳 (+8th cent.).
Pref. by Thao Thai-Ting 陶太定.
Followed by an appendix by Min I-Tê 閔一得.
In *Tao Tsang Hsü Pien* (*Chhu chi*), 10, 11.
Lun Hêng 論衡.
Discourses Weighed in the Balance.
H/Han, +82 or +83.
Wang Chhung 王充.
Tr. Forke (4); cf. Leslie (3).
Chung-Fa Index, no. 1.
Lung Hu Chhien Hung Shuo 龍虎鉛汞說.
A Discourse on the Dragon and Tiger, (Physiological) Lead and Mercury, (addressed to his younger brother Su Tzu-Yu).
Sung, c. +1100.
Su Tung-Pho 蘇東坡.
In *TSCC*, *Shen i tien*, ch. 300, *i wên*, pp. 6b ff.
Lung Hu Huan Tan Chüeh 龍虎還丹訣.
Explanation of the Dragon-and-Tiger Cyclically Transformed Elixir.
Wu Tai, Sung, or later.
Chin Ling Tzu 金陵子.
TT/902.
Lung Hu Huan Tan Chüeh Sung 龍虎還丹訣頌.
A Eulogy of the Instructions for (preparing) the Regenerative Enchymoma of the Dragon and the Tiger (Yang and Yin), [physiological alchemy].
Sung, c. +985.
Lin Ta-Ku 林大古
(Ku Shen Tzu 谷神子).
TT/1068.
Lung Hu Shang Ching Chu 龍虎上經註.
Commentary on the *Exalted Dragon-and-Tiger Manual*.
Sung.
Wang Tao 王道.
TT/988, 989.
Cf. Davis & Chao Yün-Tshung (6).
Lung Hu Ta Tan Shih 龍虎大丹詩.
Song of the Great Dragon-and-Tiger Enchymoma.
See *Chih Chen Tzu Lung Hu Ta Tan Shih*.
Lung-Shu Phu-Sa Chuan 龍樹菩薩傳.
Biography of the Bodhisattva Nāgārjuna (+2nd-century Buddhist patriarch).
Prob. Sui or Thang.
Writer unknown.
TW/2047.
Man-Anpō 萬安方.
A Myriad Healing Prescriptions.
Japan, +1315.
Kajiwaru Shozen 梶原性全.
Manyōshū 萬葉集.
Anthology of a Myriad Leaves.
Japan (Nara), +759.
Ed. Tachibana no Moroe 橋諸兄.
or Ōtomo no Yakamochi 大伴家持.
Cf. Anon. (103), pp. 14 ff.
Mao Shan Hsien Chê Fu Na Chhi Chüeh 茅山賢者服內氣訣.
Oral Instructions of the Adepts of Mao Shan for Absorbing the Chhi [Taoist breathing exercises for longevity and immortality].
Thang or Sung.
Writer unknown.
In *YCCC*, ch. 58, pp. 3b ff.
Cf. Maspero (7), p. 205.
Mao Thing Kho Hua 茅亭客話.
Discourses with Guests in the Thatched Pavilion.
Sung, before +1136.
Huang Hsiu-Fu 黃休復.
Mei-Chhi Shih Chu 梅溪詩注.
(Wang) Mei-Chhi's Commentaries on Poetry.
Short title for *Tung-Pho Shih Chi Chu* (q.v.).
Mêng Chhi Pi Than 夢溪筆談.
Dream Pool Essays.
Sung, +1086; last supplement dated +1091.
Shen Kua 沈括.
Ed. Hu Tao-Ching (1); cf. Holzman (1).
Miao Chieh Lu 妙解錄.
See *Yen Mên Kung Miao Chieh Lu*.
Miao Fa Lien Hua Ching 妙法蓮花經.
Sūtra on the Lotus of the Wonderful Law.

- Miao Fa Lien Hua Ching* (cont.)
India.
Tr. Chin, betw. +397 and +400 by Kumārajīva (Chiu-Mo-Lo-Shih 鳩摩羅什).
N/134; TW/262.
- Ming I Pieh Lu* 名醫別錄.
Informal (or Additional) Records of Famous Physicians (on Materia Medica).
Ascr. Liang, c. +510.
Attrib. Thao Hung-Ching 陶弘景.
Now extant only in quotations in the pharmaceutical natural histories, and a reconstitution by Huang Yü (1).
This work was a disentanglement, made by other hands between +523 and +618 or +656, of the contributions of Li Tang-Chih (c. +225) and Wu Phu (c. +235) and the commentaries of Thao Hung-Ching (+492) from the text of the *Shen Nung Pên Tshao Ching* itself. In other words it was the non-*Pên-Ching* part of the *Pên Tshao Ching Chü Chu* (q.v.). It may or may not have included some or all of Thao Hung-Ching's commentaries.
- Ming Shih* 明史.
History of the Ming Dynasty [+1368 to +1643].
Chhing, begun +1646, completed +1736, first pr. +1739.
Chang Thing-Yü 張廷玉 et al.
- Ming Thang Hsüan Chen Ching Chüeh* 明堂玄真經訣.
[= *Shang-Chhing Ming Thang Hsüan Chen Ching Chüeh*.]
Explanation of the Manual of (Recovering the) Mysterious Primary (Vitalities of the) Cosmic Temple (i.e. the Human Body) [respiration and heliotherapy].
S/Chhi or Liang, late +5th or early +6th (but much altered).
Attrib. to the Mother Goddess of the West, Hsi Wang Mu 西王母.
Writer unknown.
TT/421.
Cf. Maspero (7), p. 376.
- Ming Thang Yuan Chen Ching Chüeh* 明堂元真經訣.
See *Ming Thang Hsüan Chen Ching Chüeh*.
- Ming Thung Chi* 冥通記.
Record of Communication with the Hidden Ones (the Perfected Immortals).
Liang, +516.
Chou Tzu-Liang 周子良.
Ed. Thao Hung-Ching 陶弘景.
- Mo Chuang Man Lu* 墨莊漫錄.
Recollections from the Estate of Literary Learning.
Sung, c. +1131.
Chang Pang-Chi 張邦基.
- Mo O Hsiao Lu* 墨娥小錄.
A Secretary's Commonplace-Book [popular encyclopaedia].
Yuan or Ming, +14th, pr. +1571.
Compiler unknown.
- Mo Tzu* (incl. *Mo Ching*) 墨子.
The Book of Master Mo.
Chou, -4th century.
Mo Ti (and disciples) 墨翟.
Tr. Mei Yi-Pao (1); Forke (3).
Yin-Tê Index, no. (suppl.) 21.
TT/1162.
- Montoku-Yitsuroku* 文德實錄.
Veritable Records of the Reign of the Emperor Montoku [from +851 to +858].
Japan (Heian) +879.
Fujiwara Mototsune 藤原基經.
- Nan Fan Hsiang Lu* 南蕃香錄.
Catalogue of the Incense of the Southern Barbarians.
See *Hsiang Lu*.
- Nan Hai Yao Phu* 南海藥譜.
A Treatise on the Materia Medica of the South Seas (Indo-China, Malayo-Indonesia, the East Indies, etc.).
Alternative title of *Hai Yao Pên Tshao*, q.v. (according to Li Shih-Chen).
- Nan Tshun Cho Kêng Lu* 南村輟耕錄.
See *Cho Kêng Lu*.
- Nan Yo Ssu Ta Chhan-Shih Li Shih Yuan Wên* 南嶽思大禪師立誓願文.
Text of the Vows (of Aranyaka Austerities) taken by the Great Chhan Master (Hui-) Ssu of the Southern Sacred Mountain.
Chhen, c. +565.
Hui-Ssu 慧思.
TW/1933, N/1576.
- Nei Chin Tan* 內金丹.
[= *Nei Tan Pi Chih* or *Thien Hsien Chih Lun Chhang Shêng Tu Shih Nei Lien Chin Tan Fa*.]
The Metallous Enchymoma Within (the Body), [physiological alchemy].
Ming, +1622, part dated +1615.
Perhaps Chhen Ni-Wan 陳泥丸 (Mr Ni-Wan, Chhen), or Wu Chhung-Hsü 伍冲虛.
Contains a system of symbols included in the text.
CTPS, pên 12.
- Nei Ching*.
See *Huang Ti Nei Ching*, *Su Wên* and *Huang Ti Nei Ching*, *Ling Shu*.
- Nei Ching Su Wên*.
See *Huang Ti Nei Ching*, *Su Wên*.
- Nei Kung Thu Shuo* 內功訣說.
See Wang Tsu-Yuan (1).
- Nei Tan Chüeh Fa* 內丹訣法.
See *Huan Tan Nei Hsiang Chin Yo Shih*.
- Nei Tan Fu* 內丹賦.
[= *Thao Chen Jen Nai Tan Fu*.]
Rhapsodical Ode on the Physiological Enchymoma.

- Nei Tan Fu* (cont.)
Sung, +13th.
Thao Chih 陶植.
With commentary by an unknown writer.
TT/256.
Cf. *Chin Tan Fu*, the text of which is very similar.
- Nei Tan Pi Chih* 內丹秘指.
Confidential Directions on the Enchymoma.
Alternative title for *Nei Chin Tan* (q.v.).
- Nei Wai Erh Ching Thu* 內外二景圖.
Illustrations of Internal and Superficial Anatomy.
Sung, +1118.
Chu Hung 朱肱.
Original text lost, and replaced later;
drawings taken from Yang Chieh's *Tshun Chen Huan Chung Thu*.
- Neng Kai Chai Man Lu* 能改齋漫錄.
Miscellaneous Records of the Ability-to-Improve-Oneself Studio.
Sung, mid +12th century.
Wu Tshêng 吳曾.
- Ni-Wan Li Tsu Shih Nü Tsung Shuang Hsiu Pao Fa* 泥丸李祖師女宗雙修寶筏.
See *Nü Tsung Shuang Hsiu Pao Fa*.
- Nihon-Koki* 日本後記.
Chronicles of Japan, further continued [from +792 to +833].
Japan (Heian), +840.
Fujiwara Otsugu 藤原緒嗣.
- Nihon-Koku Ganzai-sho Mokuroku* 日本國見在書目錄.
Bibliography of Extant Books in Japan.
Japan (Heian), c. +895.
Fujiwara no Sukeyo 藤原佐世.
Cf. Yoshida Mitsukuni (6), p. 196.
- Nihon Sankai Meibutsu Zue* 日本山海各物圖會.
Illustrations of Japanese Processes and Manufactures (lit., of the Famous Products of Japan).
Japan (Tokugawa), Osaka, +1754.
Hirase Tessai 平瀬徹齋.
Ills. by Hasegawa Mitsunobu 長谷川光 & Chigusa Shinemon 千種屋新右衛門.
Facsim. repr. with introd. notes, Meicho Kankokai, Tokyo, 1969.
- Nihon-shoki* 日本書記.
See *Nihongi*.
- Nihon Ryo-iki* 日本靈異記.
Record of Strange and Mysterious Things in Japan.
Japan (Heian), +823.
Writer unknown.
- Nihongi* 日本記.
[= *Nihon-shoki*.]
Chronicles of Japan [from the earliest times to +696].
Japan (Nara), +720.
Toneri-shinnō (prince), 舍人親王,
Ōno Yasumaro, 大伴萬呂,
Ki no Kiyobito et al.
Tr. Aston (1).
Cf. Anon. (103), pp. 1 ff.
- Nihongi Ryaku* 日本記畧.
Classified Matters from the *Chronicles of Japan*.
Japan.
- Nittō-Guhō Junrei Gyōki* 入唐求法巡禮行記.
Record of a Pilgrimage to China in Search of the (Buddhist) Law.
Thang, +838 to +847.
Ennin 圓仁.
Tr. Reischauer (2).
- Nü Kung Chih Nan* 女功指南.
A Direction-Finder for (Inner) Achievement by Women (Taoists).
[Physiological alchemy, *nei tan* gymnastic techniques, etc.]
See *Nü Tsung Shuang Hsiu Pao Fa*.
- Nü Tsung Shuang Hsiu Pao Fa* 女宗雙修寶筏.
[= *Ni-Wan Li Tsu Shih Nü Tsung Shuang Hsiu Pao Fa*, or *Nü Kung-Chih Nan*.]
A Precious Raft (of Salvation) for Women (Taoists) Practising the Double Regeneration (of the primary vitalities, for their nature and their life-span, *hsing ming*), [physiological alchemy].
Chhing, c. +1795.
Ni-Wan shih 泥丸氏, Li Ong (late +16th), 李翁, Mr Ni-Wan, the Taoist Patriarch Li.
Written down by Thai-Hsü Ong 太虛翁, Shen I-Ping 沈一炳, Ta-Shih (Taoist abbot), c. 1820.
In *Tao Tsang Hsü Pien* (Chhu chi), 20.
Cf. *Tao Hai Chin Liang*, p. 34a, *Shih Chin Shih*, p. 12a.
- Pai hsien-sêng Chin Tan Huo Hou Thu* 白先生金丹火候圖.
Master Pai's Illustrated Tractate on the 'Fire-Times' of the Metallous Enchymoma.
Sung, c. +1210.
Pai Yü-Chhan 白玉蟾.
In *Hsiu Chen Shih Shu* (TT/260), ch. 1.
- Pao Phu Tzu* 抱朴子 (or 朴子).
Book of the Preservation-of-Solidarity Master.
Chin, early +4th century, probably c. +320.
Ko Hung 葛洪.
Partial trs. Feifel (1, 2); Wu & Davis (2)
Full tr. Ware (5), *Nei Phien* chs. only.
TT/1171-1173.
- Pao Phu Tzu Shen Hsien Chin Shuo Ching* 抱朴子神仙金鈞經.
The Preservation-of-Solidarity Master's Manual of the Bubbling Gold (Potion) of the Holy Immortals.
Ascr. Chin c. +320. Perhaps pre-Thang, more probably Thang.

- Pao Phu Tzu Shen Hsien Chin Shuo Ching (cont.)*
Attrib. Ko Hung 葛洪.
TT/910.
Cf. Ho Ping-Yü (11).
- Pao Phu Tzu Yang Sheng Lun* 抱朴子養生論.
The Preservation-of-Solidarity Master's Essay on Hygiene.
Ascr. Chin c. +320.
Attrib. Ko Hung 葛洪.
TT/835.
- Pao Sheng Hsin Chien* 保生心鑑.
Mental Mirror of the Preservation of Life [gymnastics and other longevity techniques].
Ming, +1506.
Thieh Feng chü-shih 鐵峰居士 (The Recluse of Iron Mountain, ps.).
Ed. c. +1596 by Hu Wên-Huan 胡文煥.
- Pao Shou Thang Ching Yen Fang* 保壽堂經驗方.
Tried and Tested Prescriptions of the Protection-of-Longevity Hall (a surgery or pharmacy).
Ming, c. +1450.
Liu Sung-shih 劉松石.
- Pao Tsang Lun* 寶藏論.
[= *Hsien-Yuan Pao Tsang Chhang Wei Lun*.]
(The Yellow Emperor's) Discourse on the (Contents of the) Precious Treasury (of the Earth), [mineralogy and metallurgy].
Perhaps in part Thang or pre-Thang; completed in Wu Tai (S/Han). Tsêng Yuan-jung (1) notes Chhao Kung-Wu's dating of it at +918 in his *Chhun Chai Tu Shu Chih*. Chang Tzu-Kao (2), p. 118, also considers it mainly a Wu Tai work.
Attrib. Chhing Hsia Tzu 青霞子.
If Su Yuan-Ming 蘇元明 and not another writer of the same pseudonym, the earliest parts may have been of the Chin time (+3rd or +4th); cf. Yang Lieh-Yü (1).
Now only extant in quotations.
Cf. *Lo-fou Shan Chih*, ch. 4, p. 13a.
- Pao Yen Thang Pi Chi* 寶顏堂秘笈.
Private Collection of the Pao-Yen Library.
Ming, six collections printed between +1606 and +1620.
Ed. Chhen Chi-Ju 陳繼儒.
- Pei Lu Feng Su* 北虜風俗.
[= *I Su Chi*.]
Customs of the Northern Barbarians (i.e. the Mongols).
Ming, +1594.
Hsiao Ta-Hêng 蕭大亨.
- Pei Meng So Yen* 北夢瑣言.
Fragmentary Notes Indited North of (Lake) Meng.
Wu Tai (S/Phing), c. +950.
Sun Kuang-Hsien 孫光憲.
See des Rotours (4), p. 38.
- Pei Shan Chiu Ching* 北山酒經.
Northern Mountain Wine Manual.
Sung, +1117.
Chu Hung 朱肱.
- Pei Shih* 北史.
History of the Northern Dynasties [Nan Pei Chhao period, +386 to +581].
Thang, c. +670.
Li Yen-Shou 李延壽.
For translations of passages see the index of Frankel (1).
- Pên Ching Feng Yuan* 本經逢原.
(Additions to Natural History) aiming at the Original Perfection of the *Classical Pharmacopoeia (of the Heavenly Husbandman)*.
Chhing, +1695, pr. +1705.
Chang Lu 張璐.
LPC, no. 93.
- Pên Tshao Chhiu Chen* 本草求真.
Truth Searched out in Pharmaceutical Natural History.
Chhing, +1773.
Huang Kung-Hsiu 黃宮翹.
- Pên Tshao Ching Chi Chu* 本草經集注.
Collected Commentaries on the *Classical Pharmacopoeia (of the Heavenly Husbandman)*.
S/Chhi, +492.
Thao Hung-Ching 陶弘景.
Now extant only in fragmentary form as a Tunhuang or Turfan MS., apart from the many quotations in the pharmaceutical natural histories, under Thao Hung-Ching's name.
- Pên Tshao Hui* 本草匯.
Needles from the Haystack; Selected Essentials of Materia Medica.
Chhing, +1666, pr. +1668.
Kuo Phei-Lan 郭佩蘭.
LPC, no. 84.
Cf. Swingle (4).
- Pên Tshao Hui Chien* 本草彙編.
Classified Notes on Pharmaceutical Natural History.
Chhing, begun +1660, pr. +1666.
Ku Yuan-Chiao 顧元交.
LPC, no. 83.
Cf. Swingle (8).
- Pên Tshao Kang Mu* 本草綱目.
The Great Pharmacopoeia; or, The Pan-dects of Natural History (Mineralogy, Metallurgy, Botany, Zoology etc.), Arrayed in their Headings and Sub-headings.
Ming, +1596.
Li Shih-Chen 李時珍.
Paraphrased and abridged tr. Read & collaborators (2-7) and Read & Pak (1) with indexes. Tabulation of plants in Read (1) (with Liu Ju-Chiang).
Cf. Swingle (7).

- Pên Tshao Kang Mu Shih I* 本草綱目拾遺.
Supplementary Amplifications for the
Pandects of Natural History (of Li Shih-
Chen).
Chhing, begun c. +1760, first prefaced
+1765, prolegomena added +1780, last
date in text 1803.
Chhing, first pr. 1871.
Chao Hsüeh-Min 趙學敏.
LPC, no. 101.
Cf. Swingle (11); Chang Tzu-Kao (5).
- Pên Tshao Méng Chhüan* 本草蒙筌.
Enlightenment on Pharmaceutical Natural
History.
Ming, +1565.
Chhen Chia-Mo 陳嘉謨.
Pên Tshao Pei Yao 本草備要.
Practical Aspects of Materia Medica.
Chhing, c. +1690, second ed. +1694.
Wang Ang 汪昂.
LPC, no. 90; ICK, pp. 215 ff.
Cf. Swingle (4).
- Pên Tshao Phin Hui Ching Yao* 本草品彙精要.
Essentials of the Pharmacopoeia Ranked
according to Nature and Efficacy (Im-
perially Commissioned).
Ming, +1505.
Liu Wên-Thai 劉文泰, Wang Phan 王磐
& Kao Thing-Ho 高廷和.
Pên Tshao Shih I 本草拾遺.
A Supplement for the Pharmaceutical
Natural Histories.
Thang, c. +725.
Chhen Tshang-Chhi 陳藏器.
Now extant only in numerous quotations.
- Pên Tshao Shu* 本草述.
Explanations of Materia Medica.
Chhing, before +1665, first pr. +1700.
Liu Jo-Chin 劉若金.
LPC, no. 79.
Cf. Swingle (6).
- Pên Tshao Shu Kou Yuan* 本草述鉤元.
Essentials Extracted from the *Explanations*
of *Materia Medica*.
See Yang Shih-Thai (1).
Pên Tshao Thu Ching 本草圖經.
Illustrated Pharmacopoeia; or, Illustrated
Treatise of Pharmaceutical Natural
History.
Sung, +1061.
Su Sung 蘇頌 et al.
Now preserved only in numerous quota-
tions in the later pandects of pharma-
ceutical natural history.
- Pên Tshao Thung Hsüan* 本草通玄.
The Mysteries of Materia Medica Un-
veiled.
Chhing, begun before +1655, pr. just
before +1667.
Li Chung-Tzu 李中梓.
LPC, no. 75.
Cf. Swingle (4).
- Pên Tshao Tshung Hsin* 本草從新.
New Additions to Pharmaceutical Natural
History.
Chhing, +1757.
Wu I-Lo 吳儀洛.
LPC, no. 99.
- Pên Tshao Yao Hsing* 本草藥性.
The Natures of the Vegetable and Other
Drugs in the Pharmaceutical Treatises.
Thang, c. +620.
Chen Li-Yen 甄立言 & (perhaps) Chen
Chhüan 甄權.
Now extant only in quotations.
- Pên Tshao Yen I* 本草衍義.
Dilations upon Pharmaceutical Natural
History.
Sung, pref. +1116, pr. +1119, repr. +1185,
+1195.
Khou Tsung-Shih 寇宗奭.
See also *Thu Ching Yen I Pên Tshao*
(TT/761).
- Pên Tshao Yen I Pu I* 本草衍義補遺.
Revision and Amplification of the *Dilations*
upon *Pharmaceutical Natural History*.
Yuan, c. +1330.
Chu Chen-Hêng 朱震亨.
LPC, no. 47.
Cf. Swingle (12).
- Pên Tshao Yuan Shih* 本草原始.
Objective Natural History of Materia
Medica; a True-to-Life Study.
Chhing, begun +1578, pr. +1612.
Li Chung-Li 李中立.
LPC, no. 60.
- Phan Shan Yü Lu* 盤山語錄.
Record of Discussions at Phan Mountain
[dialogues of pronouncedly medical
character on physiological alchemy].
Sung, prob. early +13th.
Writer unknown.
In *Hsiu Chen Shih Shu* (TT/260), ch. 53.
- Phêng-Lai Shan Hsi Tsao Huan Tan Ko* 蓬萊
山西僊還丹歌.
Mnemonic Rhymes of the Cyclically
Transformed Elixir from the Western
Furnace on Phêng-lai Island.
Ascr. c. -98. Probably Thang.
Huang Hsüan-Chung 黃玄鍾.
TT/909.
- Phêng Tsu Ching* 彭祖經.
Manual of Phêng Tsu [Taoist sexual tech-
niques and their natural philosophy].
Late Chou or C/Han, -4th to -1st.
Attrib. Phêng Tsu 彭祖.
Only extant as fragments in *C/SHK*
(Shang Ku Sect.), ch. 16, pp. 5b ff.
- Phu Chi Fang* 普濟方.
Practical Prescriptions for Everyman.
Ming, c. +1418.
Chu Hsiao 朱橚 (Chou Ting Wang 周定王,
prince of the Ming).
ICK, p. 914.

- Pi Yü Chu Sha Han Lin Yü Shu Kuei* 碧玉朱砂寒林玉樹圖.
On the Caerulean Jade and Cinnabar Jade-Tree-in-a-Cold-Forest Casing Process.
Sung, early + 11th cent.
Chhen Ching-Yuan 陳景元.
TT/891.
- Pien Huo Pien* 辯惑編.
Disputations on Doubtful Matters.
Yuan, + 1348.
Hsieh Ying-Fang 謝應芳.
- Pien Tao Lun* 辨道論.
On Taoism, True and False.
San Kuo (Wei), c. + 230.
Tshao Chih (prince of the Wei), 曹植.
Now extant only in quotations.
- Po Wu Chi* 博物記.
Notes on the Investigation of Things.
H/Han, c. + 190.
Thang Mêng (b) 唐蒙.
- Po Wu Chih* 博物志.
Records of the Investigation of Things (cf. *Hsü Po Wu Chih*).
Chin, c. + 290 (begun about + 270).
Chang Hua 張華.
- Pu Wu Yao Lan* 博物要覽.
The Principal Points about Objects of Art and Nature.
Ming, c. + 1560.
Ku Thai 谷泰.
- Rokubutsu Shinshi* 六物新志.
New Record of Six Things [including the drug *mumia*]. (In part a translation from Dutch texts).
Japan, + 1786.
Ôtsuki Gentaku 大槻玄澤.
- San Chen Chih Yao Yü Chüeh* 三真旨要玉訣.
Precious Instructions concerning the Message of the Three Perfected (Immortals), [i.e. Yang Hsi (fl. + 370) 楊羲; Hsü Mi (fl. + 345) 許謐; and Hsü Hui (d. c. + 370) 許翹].
Taoist heliotherapy, respiration and meditation.
Chin, c. + 365, edited probably in the Thang.
TT/419.
Cf. Maspero (7), p. 376.
- San-Fêng Chen Yen Hsüan Than Chhüan Chi* 三峯真人玄譚全集.
Complete Collection of the Mysterious Discourses of the Adept (Chang) San-Fêng [physiological alchemy].
Ming, from c. + 1410 (if genuine).
Attrib. Chang San-Fêng 張三峯.
Ed. Min I-Tê (1834) 閔一得.
In *Tao Tsang Hsü Pien* (Chhu chi), 17.
- San-Fêng Tan Chüeh* 三峯丹訣 (includes *Chin Tan Chieh Yao* and *Tshai Chen Chi Yao*,

- with the *Wu Kên Shu* series of poems, and some inscriptions).
Oral Instructions of (Chang) San-Fêng on the Enchymoma [physiological alchemy].
Ming, from c. + 1410 (if genuine).
Attrib. Chang San-Fêng 張三峯.
Ed., with biography, by Fu Chin-Chhüan 傅金餘 (Chi I Tzu 濟一子) c. 1820.
- San Phin I Shen Pao Ming Shen Tan Fang* 三品頤神保命神丹方.
Efficacious Elixir Prescriptions of Three Grades Inducing the Appropriate Mentality for the Enterprise of Longevity.
Thang, Wu Tai & Sung.
Writers unknown.
YCCC, ch. 78, pp. 1a ff.
- San-shih-liu Shui Fa* 三十六水法.
Thirty-six Methods for Bringing Solids into Aqueous Solution.
Pre-Thang.
Writer unknown.
TT/923.
- San Tshai Thu Hui* 三才圖會.
Universal Encyclopaedia.
Ming, + 1609.
Wang Chhi 王圻.
- San Tung Chu Nang* 三洞珠囊.
Bag of Pearls from the Three (Collections that) Penetrate the Mystery [a Taoist florilegium].
Thang, + 7th.
Wang Hsüan-Ho (ed.) 王懸河.
TT/1125.
Cf. Maspero (13), p. 77; Schipper (1), p. 11.
- San Yen* 三言.
See *Hsing Shih Hêng Yen*, *Yü Shih Ming Yen*, *Ching Shih Thung Yen*.
- Setsuyô Yoketsu*.
See *Shê Yang Yao Chüeh*.
- Shan Hai Ching* 山海經.
Classic of the Mountains and Rivers.
Chou and C/Han, -8th to -1st.
Writers unknown.
Partial tr. de Rosny (1).
Chung-Fa Index, no. 9.
- Shang-Chhing Chi* 上清集.
A Literary Collection (inspired by) the Shang-Chhing Scriptures [prose and poems on physiological alchemy].
Sung, c. + 1220.
Ko Chhang-Kêng 葛長庚 (Pai Yü-chhan 白玉蟾).
In *Hsiu Chen Shih Shu* TT/260, chs. 37 to 44.
- Shang-Chhing Ching* 上清經.
[Part of *Thai Shang San-shih-liu Pu Tsun Ching*.]
The Shang-Chhing (Heavenly Purity) Scripture.
Chin, oldest parts date from about + 316.
Attrib. Wei Hua-Tshun 魏華存, dictated to Yang Hsi 楊羲.
In TT/8.

- Shang-Chhing Chiu Chen Chung Ching Nei Chüeh* 上清九真中經內訣.
Confidential Explanation of the Interior Manual of the Nine (Adepts); a Shang-Chhing Scripture.
Ascr. Chin, +4th, probably pre-Thang.
Attrib. Chhih Sung Tzu 赤松子 (Huang Chhu-Phing 黃初平).
TT/901.
- Shang-Chhing Han Hsiang Chien Chien Thu* 上清含象劍鑑圖.
The Image and Sword Mirror Diagram; a Shang-chhing Scripture.
Thang, c. +700.
Ssuma Chhêng-Chên 司馬承貞.
TT/428.
- Shang-Chhing Hou Shêng Tao Chün Lieh Chi* 上清後聖道君列紀.
Annals of the Latter-Day Sage, the Lord of the Tao; a Shang-Chhing Scripture.
Chin, late +4th.
Revealed to Yang Hsi 楊羲.
TT/439.
- Shang-Chhing Huang Shu Kuo Tu I* 上清黃書過度儀.
The System of the Yellow Book for Attaining Salvation; a Shang-Chhing Scripture [the rituale of the communal Taoist liturgical sexual ceremonies, +2nd to +7th centuries].
Date unknown, but pre-Thang.
Writer unknown.
TT/1276.
- Shang-Chhing Ling-Pao Ta Fa* 上清靈寶大法.
The Great Liturgies; a Shang-Chhing Ling-Pao Scripture.
Sung, +13th.
Chin Yün-Chung 金允中.
TT/1204, 1205, 1206.
- Shang-Chhing Ming Thang Hsüan Chen Ching Chüeh* 上清明堂玄真經訣.
See *Ming Thang Hsüan Chen Ching Chüeh*.
Shang-Chhing San Chen Chih Yao Yü Chüeh 上清三真旨要玉訣.
See *San Chen Chih Yao Yü Chüeh*.
Shang-Chhing Thai-Shang Pa Su Chen Ching 上清太上八素真經.
Realisation Canon of the Eight Purifications (or Eightfold Simplicity); a Shang-Chhing Thai-Shang Scripture.
Date uncertain, but pre-Thang.
Writer unknown.
TT/423.
- Shang-Chhing Thai-Shang Ti Chün Chiu Chen Chung Ching* 上清太上帝君九真中經.
Ninefold Realised Median Canon of the Imperial Lord; a Shang-Chhing Thai-Shang Scripture.
Compiled from materials probably of Chin period, late +4th.
Writers and editor unknown.
TT/1357.
- Shang-Chhing Tung-Chen Chiu Kung Tzu Fang Thu* 上清洞真九宮紫房圖.
Description of the Purple Chambers of the Nine Palaces; a Tung-Chen Scripture of the Shang-Chhing Heavens [parts of the microcosmic body corresponding to stars in the macrocosm].
Sung, probably +12th century.
Writer unknown.
TT/153.
- Shang-Chhing Wo Chung Chüeh* 上清握中訣.
Explanation of (the Method of) Grasping the Central (Luminary); a Shang-Chhing Scripture [Taoist meditation and heliotherapy].
Date unknown, Liang or perhaps Thang.
Writer unknown.
Based on the procedures of Fan Yu-Chhung 范幼沖 (H/Han).
TT/137.
Cf. Maspero (7), p. 373.
- Shang Phin Tan Fa Chieh Tzhu* 上品丹法節次.
Expositions of the Techniques for Making the Best Quality Enchymoma [physiological alchemy].
Chhing.
Li Tê-Hsia 李德洽.
Comm. Min I-Tê 閔一德, c. 1830.
In *Tao Tsang Hsü Pien (Chhu chi)*, 6.
- Shang Shu Ta Chuan* 尚書大傳.
Great Commentary on the *Shang Shu* chapters of the *Historical Classic*.
C/Han, c. -185.
Fu Shêng 伏勝.
Cf. Wu Khang (1), p. 230.
- Shang-Tung Hsin Tan Ching Chüeh* 上洞心丹經訣.
An Explanation of the Heart Elixir and Enchymoma Canon; a Shang-Tung Scripture.
Date unknown, perhaps Sung.
Writer unknown.
TT/943.
Cf. Chhen Kuo-Fu (1), vol. 2, pp. 389, 435.
- Shang Yang Tzu Chin Tan Ta Yao* 上陽子金丹大要.
See *Chin Tan Ta Yao*.
Shang Yang Tzu Chin Tan Ta Yao Hsien Phai (Yuan Liu) 上陽子金丹大要仙派 (源流).
See *Chin Tan Ta Yao Hsien Phai (Yuan Liu)*.
Shang Yang Tzu Chin Tan Ta Yao Lieh Hsien Chih 上陽子金丹大要列仙誌.
See *Chin Tan Ta Yao Lieh Hsien Chih*.
Shang Yang Tzu Chin Tan Ta Yao Thu 上陽子金丹大要圖.
See *Chin Tan Ta Yao Thu*.
Shao-Hsing Chiao-Ting Ching-Shih Cheng Lei Pei-Chi Pên Tshao 紹興校定經史證類備急本草.

- Shao-Hsing Chiao-Ting Ching-Shih Cheng Lei*
Pei-Chi Pên Tshao (cont.)
 The Corrected Classified and Consolidated
 Armamentarium; Pharmacopoeia of the
 Shao-Hsing Reign-Period.
 S/Sung, pres. +1157, pr. +1159, often
 copied and repr. especially in Japan.
 Thang Shen-Wei 唐慎微 ed. Wang Chi-
 Hsien 王繼先 *et al.*
 Cf. Nakao Manzō (1, 1); Swingle (11).
 Illustrations reproduced in facsimile by
 Wada (1); Karow (2).
 Facsimile edition of a MS. in the Library of
 Ryokoku University, Kyoto 龍谷大學
 圖書館.
 Ed. with an analytical and historical intro-
 duction, including contents table and in-
 dexes (別冊) by Okanishi Tameto 岡西
 爲人 (Shunyōdō, Tokyo, 1971).
- Shē Ta Chhēng Lun Shih* 攝大藥論釋.
Mahāyāna-saṃgraha-bhāṣya (Explanatory
 Discourse to assist the Understanding of
 the Great Vehicle).
 India, betw. +300 and +500.
 Tr. Hsüan-Chuang 玄奘, c. +650.
 N/1171 (4); TW/1597.
- (*Shē Yang*) *Chen Chung Chi (or Fang)* (攝養) 枕
 中記 (方).
 Pillow-Book on Assisting the Nourishment
 (of the Life-Force).
 Thang, early +7th.
 Attrib. Sun Ssu-Mo 孫思邈.
 TT/830, and in YCCC, ch. 33.
- Shē Yang Yao Chüeh (Setsuyō Yoketsu)* 攝養要訣.
 Important Instructions for the Preservation
 of Health conducive to Longevity.
 Japan (Heian), c. +820.
 Mononobe Kōsen (imperial physician)
 物部廣泉.
- Shen Hsien Chin Shuo Ching* 神仙金鈞經.
 See *Pao Phu Tzu Shen Hsien Chin Shuo*
Ching.
- Shen Hsien Chuan* 神仙傳.
 Lives of the Holy Immortals.
 (Cf. *Lieh Hsien Chuan* and *Hsü Shen Hsien*
Chuan.)
 Chin, +4th century.
 Attrib. Ko Hung 葛洪.
- Shen Hsien Fu Erh Tan Shih Hsing Yao Fa*
 神仙服餌丹石行藥法.
 The Methods of the Holy Immortals for
 Ingesting Cinnabar and (Other)
 Minerals, and Using them Medicinally.
 Date unknown.
 Attrib. Ching-Li hsien-sêng 京里先生.
 TT/417.
- Shen Hsien Fu Shih Ling-Chih Chhang-Phu Wan*
 神仙服食靈芝萐蒲丸方.
 Prescriptions for Making Pills from
 Numinous Mushrooms and Sweet Flag
 (*Calamus*), as taken by the Holy Immortals.
 Date unknown.
- Writer unknown.
 TT/837.
- Shen Hsien Lien Tan Tien Chu San Yuan Pao*
Ching Fa 神仙鍊丹點鑪三元寶鏡法.
 Methods used by the Holy Immortals to
 Prepare the Elixir, Project it, and Cast
 the Precious Mirrors of the Three Powers
 (or the Three Primary Vitalities), [magical].
 Thang, +902.
 Writer unknown.
 TT/856.
- Shen Hsien Thung Chien* 神仙通鑑.
 (Cf. (*Li Tai*) *Shen Hsien (Thung) Chien*.)
 General Survey of the Lives of the Holy
 Immortals.
 Ming, +1640.
 Hsüeh Ta-Hsün 薛大訓.
- Shen I Chi* 神異記.
 (Probably an alternative title of *Shen I*
Ching, q.v.)
 Records of the Spiritual and the Strange.
 Chin, c. +290.
 Wang Fou 王浮.
- Shen I Ching* 神異經.
 Book of the Spiritual and the Strange.
 Ascr. Han, but prob. +3rd, +4th or +5th
 century.
 Attrib. Tungfang Shuo 東方朔.
 Probable author, Wang Fou 王浮.
- Shen Nung Pên Tshao Ching* 神農本草經.
 Classical Pharmacopoeia of the Heavenly
 Husbandman.
 C/Han, based on Chou and Chhin material,
 but not reaching final form before the
 +2nd century.
 Writers unknown.
 Lost as a separate work, but the basis of all
 subsequent compendia of pharmaceutical
 natural history, in which it is constantly
 quoted.
 Reconstituted and annotated by many
 scholars; see Lung Po-Chien (1), pp. 2 ff.,
 12 ff.
 Best reconstructions by Mori Tateyuki
 森立之 (1845), Liu Fu 劉復 (1942).
- Shen shih Liang Fang* 沈氏良方.
 Original title of *Su Shen Liang Fang* (q.v.).
- Shen Thien-Shih Fu Chhi Yao Chüeh* 申天師
 服氣要訣.
 Important Oral Instructions of the Heavenly
 Teacher (or Patriarch) Shen on the
 Absorption of the Chhi [Taoist breathing
 exercises].
 Thang, c. +730.
 Shen Yuan-Chih 申元之.
 Now extant only as a short passage in
 YCCC, ch. 59, pp. 166 ff.
- Shêng Chi Tsung Lu* 聖濟總錄.
 Imperial Medical Encyclopaedia [issued by
 authority].
 Sung, c. +1111 to +1118.
 Ed. by twelve physicians.

- Shêng Shih Miao Ching* 生尸妙經.
See *Thai-Shang Tung-Hsüan Ling-Pao Mieh Tu* (or *San Yuan*) *Wu Lien Shêng Shih Miao Ching*.
- Shêng Shui Yen Than Lu* 滙水燕談錄.
Fleeting Gossip by the River Shêng [in Shantung].
Sung, late +11th century (before +1094).
Wang Phi-Chih 王闢之.
- Shih Chin Shih* 試金石.
On the Testing of (what is meant by) 'Metal' and 'Mineral'.
See *Fu Chin-Chhüan* (5).
- Shih Han Chi* 石函記.
See *Hsü Chen Chün Shih Han Chi*.
- Shih I Chi* 拾遺記.
Memoirs on Neglected Matters.
Chin, c. +370.
Wang Chia 王嘉.
Cf. *Eichhorn* (5).
- Shih I Tê Hsiao Fang* 世醫得効方.
Efficacious Prescriptions of a Family of Physicians.
Yuan, +1337.
Wei I-Lin 危亦林.
- Shih Liao Pên Tshao* 食療本草.
Nutritional Therapy; a Pharmaceutical Natural History.
Thang, c. +670.
Mêng Shen 孟詵.
- Shih Lin Kuang Chi* 事林廣記.
Guide through the Forest of Affairs [encyclopaedia].
Sung, between +1100 and +1250; first pr. +1325.
Chhen Yuan-Ching 陳元靚.
(A unique copy of a Ming edition of +1478 is in the Cambridge University Library.)
- Shih Ming* 釋名.
Explanation of Names [dictionary].
H/Han, c. +100.
Liu Hsi 劉熙.
- Shih Pien Liang Fang* 十便良方.
Excellent Prescriptions of Perfect Convenience.
Sung, +1196.
Kuo Than 郭坦.
Cf. *SIC*, p. 1119; *ICK*, p. 813.
- Shih Wu Chi Yuan* 事物紀原.
Records of the Origins of Affairs and Things.
Sung, c. +1085.
Kao Chhêng 高承.
- Shih Wu Pên Tshao* 食物本草.
Nutritional Natural History.
Ming, +1571 (repr. from a slightly earlier edition).
Attrib. Li Kao 李杲 (I/Chin) or Wang Ying 汪穎 (Ming); various editions; actual writer Lu Ho 盧和.
The bibliography of this work in its several different forms, together with the questions of authorship and editorship, are complex.
See *Lung Po-Chien* (1), pp. 104, 105, 106; *Wang Yü-Hu* (1), 2nd ed. p. 194; *Swingle* (1, 10).
- Shih Yao Erh Ya* 石藥爾雅.
The Literary Expositor of Chemical Physic; or, Synonymic Dictionary of Minerals and Drugs.
Thang, +806.
Mei Piao 梅彪.
TT/894.
- Shih Yuan* 事原.
On the Origins of Things.
Sung.
Chu Hui 朱熹.
- Shoku-Nihongi* 續日本記.
Chronicles of Japan, continued [from +697 to +791].
Japan (Nara), +797.
Ishikawa Natari 石川,
Fujiwara Tsuginawa 藤原繼繩,
Sugeno Sanemichi 菅野真道 *et al.*
- Shoku-Nihonkoki* 續日本後記.
Chronicles of Japan, still further continued [from +834 to +850].
Japan (Heian), +869.
Fujiwara Yoshifusa 藤原良房.
- Shou Yü Shen Fang* 壽域神方.
Magical Prescriptions of the Land of the Old.
Ming, c. +1430.
Chu Chhüan 朱權 (Ning Hsien Wang 寧獻王, prince of the Ming).
- Shu Shu Chi I* 數術記遺.
Mémorial on some Traditions of Mathematical Art.
H/Han, +190, but generally suspected of having been written by its commentator Chen Luan 甄鸞, c. +570. Some place the text as late as the Wu Tai period (+10th. cent.), e.g. *Hu Shih*; and others such as *Li Shu-Hua* (2) prefer a Thang dating.
Hsü Yo 徐岳.
- Shu Yuan Tsa Chi* 菰園雜記.
The Bean-Garden Miscellany.
Ming, +1475.
Lu Jung 陸容.
- Shuang Mei Ching An Tshung Shu* 雙梅景閣叢書.
Double Plum-Tree Collection [of ancient and medieval books and fragments on Taoist sexual techniques].
See *Yeh Tê-Hui* (1) 葉德輝 in *Bib. B.*
- Shui Yün Lu* 水雲錄.
Record of Clouds and Waters [iatrochemical].
Sung, c. +1125.
Yeh Mêng-Tê 葉夢得.
Extant now only in quotations.

- Shun Yang Lü Chen-jen Yao Shih Chih* 純陽
呂真人藥石製.
The Adept Lü Shun-Yang's (i.e. Lü
Tung-Pin's) Book on Preparations of
Drugs and Minerals [in verses].
Late Thang.
Attrib. Lü Tung-Pin 呂洞賓.
TT/896.
Tr. Ho Ping-Yü, Lim & Morsingh (1).
- Shuo Wên*.
See *Shuo Wên Chieh Tzu*.
Shuo Wên Chieh Tzu 說文解字.
Analytical Dictionary of Characters (lit.
Explanations of Simple Characters and
Analyses of Composite Ones).
H/Han, +121.
Hsü Shen 許慎.
So Sui Lu 瑣碎錄.
Sherds, Orts and Unconsidered Fragments
[iatro-chemical].
Sung, prob. late +11th.
Writer unknown.
Now extant only in quotations. Cf. *Winter's
Tale*, iv, iii, *Timon of Athens*, iv, iii, and
Julius Caesar, iv, i.
- Sou Shen Chi* 搜神記.
Reports on Spiritual Manifestations.
Chin, c. +348.
Kan Pao 干寶.
Partial tr. Bodde (9).
- Sou Shen Hou Chi* 搜神後記.
Supplementary Reports on Spiritual
Manifestations.
Chin, late +4th or early +5th century.
Thao Chhien 陶潛.
- Ssu Khu Thi Yao Pien Cheng* 四庫提要辨證.
See Yü Chia-Hsi (1).
- Ssu Shêng Pên Tshao* 四聲本草.
Materia Medica Classified according to the
Four Tones (and the Standard Rhymes),
[the entries arranged in the order of the
pronunciation of the first character of
their names].
Thang, c. +775.
Hsiao Ping 蕭炳.
- Ssu Shih Thiao Shê Chien* 四時調攝箋.
Directions for Harmonising and Strengthen-
ing (the Vitalities) according to the Four
Seasons of the Year [the second part
(chs. 3-6) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高濂.
Partial tr. of the gymnastic material,
Dudgeon (1).
- Ssu Shih Tsuan Yao* 四時纂要.
Important Rules for the Four Seasons
[agriculture and horticulture, family
hygiene and pharmacy, etc.].
Thang, c. +750.
Han O 韓鄂.
- Su Nü Ching* 素女經.
Canon of the Immaculate Girl.
Han.
Writer unknown.
Only as fragment in *Shuang Mei Ching An
Tshung Shu*, now containing the *Hsüan Nü
Ching* (q.v.).
Partial trs. van Gulik (3, 8).
- Su Nü Miao Lun* 素女妙論.
Mysterious Discourses of the Immaculate
Girl.
Ming, c. +1500.
Writer unknown.
Partial tr. van Gulik (3).
- Su Shen Liang Fang* 蘇沈良方.
Beneficial Prescriptions collected by Su
(Tung-Pho) and Shen (Kua).
Sung, c. +1120. Some of the data go back
as far as +1060. Preface by Lin Ling-Su
林靈素.
Shen Kua 沈括 and Su Tung-Pho
蘇東坡 (posthumous).
The collection was at first called *Shen
shih Liang Fang*, so that most of the
entries are Shen Kua's, but as some cer-
tainly stem from Su Tung-Pho, the latter
were probably added by editors at the
beginning of the new century.
Cf. ICK, pp. 737, 732.
- Su Wên Ling Shu Ching*.
See *Huang Ti Nei Ching*, *Su Wên* and
Huang Ti Nei Ching, *Ling Shu*.
- Su Wên Nei Ching*.
See *Huang Ti Nei Ching*, *Su Wên*.
- Sui Shu* 隋書.
History of the Sui Dynasty [+581 to
+617].
Thang, +636 (annals and biographies);
+656 (monographs and bibliography).
Wei Chêng 魏徵 *et al.*
Partial trs. Pfizmaier (61-65); Balazs (7, 8);
Ware (1).
For translations of passages see the index of
Frankel (1).
- Sun Kung Than Phu* 孫公談圃.
The Venerable Mr Sung's Conversation
Garden.
Sung, c. +1085.
Sun Shêng 孫升.
- Sung Chhao Shih Shih* 宋朝事實.
Records of Affairs of the Sung Dynasty.
Yuan, +13th.
Li Yu 李攸.
- Sung Shan Thai-Wu hsien-sêng Chhi Ching*
嵩山太无先生氣經.
Manual of the (Circulation of the) Chhi,
by Mr Grand-Nothingness of Sung
Mountain.
Thang, +766 to +779.
Prob. Li Fêng-Shih 李奉時 (Thai-Wu
hsien-sêng).
TT/817, and in YCCC, ch. 59 (partially),
pp. 7a ff.
Cf. Maspero (7), p. 199.

- Sung Shih* 宋史.
History of the Sung Dynasty [+960 to +1279].
Yuan, c. +1345.
Tho-Tho (Toktaga) 脫脫 & Ouyang Hsüan 歐陽玄.
Yin-Tê Index, no. 34.
- Szechuan Thung Chih* 四川通志.
General History and Topography of Szechuan Province.
Chhing, +18th century (pr. 1816).
Ed. Chhang Ming 常明, Yang Fang-Tshan 楊芳燦 *et al.*
- Ta Chao* 大招.
The Great Summons (of the Soul), [ode].
Chhu (between Chhin and Han), -206 or -205.
Writer unknown.
Tr. Hawkes (1), p. 109.
- Ta Chih Tu Lun* 大智度論.
Mahā-prajñāpāramitā-padeśa Śāstra (Commentary on the Great Sūtra of the Perfection of Wisdom).
India.
Attrib. Nāgārjuna, +2nd.
Mostly prob. of Central Asian origin.
Tr. Kumārajīva, +406.
N/1169; TW/1509.
- Ta Chün Ku Thung* 大鈞鼓銅.
(Illustrated Account of the Mining), Smelting and Refining of Copper [and other Non-Ferrous Metals], according to the Principles of Nature (lit. the Great Potter's Wheel).
See Masuda Tsuna (1).
- Ta Fang Kuang Fo Hua Yen Ching* 大方廣佛華嚴經.
Avatamsaka Sūtra.
India.
Tr. Śikshānanda, +699.
N/88; TW/279.
- Ta Huan Tan Chao Chien* 大還丹照鑑.
An Elucidation of the Great Cyclically Transformed Elixir [in verses].
Wu Tai (Shu), +962.
Writer unknown.
TT/919.
- Ta Huan Tan Chhi Pi Thu* 大還丹契祕圖.
Esoteric Illustrations of the Concordance of the Great Regenerative Enchymoma.
Thang or Sung.
Writer unknown.
In YCCC, ch. 72, pp. 1a ff.
Cf. *Hsiu Chen Li Yen Chhao Thu* and *Chin I Huan Tan Yin Chheng Thu*.
- Ta-Kuan Ching-Shih Chheng Lei Pei-Chi Pên Tshao* 大觀經史證類備急本草.
The Classified and Consolidated Armamentarium; Pharmacopoeia of the Ta-Kuan reign-period.
Sung, +1108; repr. +1211, +1214 (J/Chin), +1302 (Yuan).
- Thang Shen-Wei 唐慎微.
Ed. Ai Shêng 艾晟.
- Ta Ming I Thung Chih* 大明一統志.
Comprehensive Geography of the (Chinese) Empire (under the Ming dynasty).
Ming, commissioned +1450, completed +1461.
Ed. Li Hsien 李賢.
- Ta Tai Li Chi* 大戴禮記.
Record of Rites [compiled by Tai the Elder] (cf. *Hsiao Tai Li Chi*; *Li Chi*).
Ascr. C/Han, c. -70 to -50, but really H/Han, between +80 and +105.
Attrib. ed. Tai Tê 戴德, in fact probably ed. Tshao Pao 曹褒.
See Legge (7).
Trs. Douglas (1); R. Wilhelm (6).
- Ta Tan Chhien Hung Lun* 大丹鉛汞論.
Discourse on the Great Elixir [or Enchymoma] of Lead and Mercury.
If Thang, +9th, more probably Sung.
Chin Chu-Pho 金竹坡.
TT/916.
Cf. Yoshida Mitsukuni (5), pp. 230-2.
- Ta Tan Chi* 大丹記.
Record of the Great Enchymoma.
Ascr. +2nd cent., but probably Sung, +13th.
Attrib. Wei Po-Yang 魏伯陽.
TT/892.
- Ta Tan Chih Chih* 大丹直指.
Direct Hints on the Great Elixir.
Sung, c. +1200.
Chhiu Chhu-Chi 邱處機.
TT/241.
- Ta Tan Wên Ta* 大丹問答.
Questions and Answers on the Great Elixir (or Enchymoma) [dialogues between Chêng Yin and Ko Hung].
Date unknown, prob. late Sung or Yuan.
Writer unknown.
TT/932.
- Ta Tan Yao Chüeh Pên Tshao* 大丹藥訣本草.
Pharmaceutical Natural History in the form of Instructions about Medicines of the Great Elixir (Type), [iatro-chemical].
Possible alternative title of *Wai Tan Pên Tshao* (q.v.).
- Ta-Tung Lien Chen Pao Ching, Chiu Huan Chin Tan Miao Chüeh* 大洞鍊真寶經九還金丹妙訣.
Mysterious Teachings on the Ninefold Cyclically Transformed Gold Elixir, supplementary to the Manual of the Making of the Perfected Treasure; a Ta-Tung Scripture.
Thang, +8th, perhaps c. +712.
Chhen Shao-Wei 陳少微.
TT/884. A sequel to TT/883, and in YCCC, ch. 68, pp. 8a ff.
Tr. Sivin (4).

- Ta-Tung Lien Chen Pao Ching, Hsiu Fu Ling*
Sha Miao Chüeh 大洞鍊真寶經修伏靈
 砂妙訣.
 Mysterious Teachings on the Alchemical
 Preparation of Numinous Cinnabar, sup-
 plementary to the Manual of the Making
 of the Perfected Treasure; a Ta-Tung
 Scripture.
 Thang, +8th, perhaps c. +712.
 Chhen Shao-Wei 陳少微.
 TT/883. Alt. title: *Chhi Fan Ling Sha Lun*,
 as in YCCC, ch. 69, pp. 1a ff.
 Tr. Sivin (4).
- Ta Yu Miao Ching* 大有妙經.
 [= *Tung-Chen Thai-Shang Su-Ling Tung-
 Yuan Ta Yu Miao Ching*.]
 Book of the Great Mystery of Existence
 [Taoist anatomy and physiology; describes
 the *shang tan thien*, upper region of vital
 heat, in the brain].
 Chin, +4th.
 Writer unknown.
 TT/1295.
 Cf. Maspero (7), p. 192.
- Tai I Phien* 代疑篇.
 On Replacing Doubts by Certainties.
 Ming, +1621.
 Yang Thing-Yün 楊廷筠.
 Preface by Wang Chêng 王徵.
- Taketori Monogatari* 竹取物語.
 The Tale of the Bamboo-Gatherer.
 Japan (Heian), c. +865. Cannot be earlier
 than c. +810 or later than c. +955.
 Writer unknown.
 Cf. Matsubara Hisako (1, 2).
- Tan Ching Shih Tu* 丹經示讀.
 A Guide to the Reading of the Enchymoma
 Manuals.
 See Fu Chin-Chhüan (3).
- Tan Ching Yao Chüeh*.
 See *Thai-Chhing Tan Ching Yao Chüeh*.
- Tan Fang Ao Lun* 丹房奧論.
 Subtle Discourse on the (Alchemical)
 Laboratory (of the Human Body, for
 making the Enchymoma).
 Sung, +1020.
 Chhêng Liao-I 程了一.
 TT/913, and in *TTCY* (*chung mao chi*,
 5).
- Tan Fang Chien Yuan* 丹方鑑源.
 The Mirror of Alchemical Processes (and
 Reagents); a Source-book.
 Wu Tai (H/Shu), c. +938 to +965.
 Tuku Thao 獨孤慆.
 Descr. Fêng Chia-Lo & Collier (1).
 See Ho Ping-Yü & Su Ying-Hui (1).
 TT/918.
- Tan Fang Ching Yuan* 丹房鏡源.
 The Mirror of the Alchemical Laboratory;
 a Source-book.
 Early Thang, not later than +800.
 Writer unknown.
- Survives only incorporated in *TT/912* and
 in *CLPT*.
 See Ho Ping-Yü & Su Ying-Hui (1).
- Tan Fang Hsü Chih* 丹房須知.
 Indispensable Knowledge for the Chymical
 Laboratory [with illustrations of apparatus].
 Sung, +1163.
 Wu Wu 吳愷.
 TT/893.
- Tan Fang Pao Chien Chih Thu* 丹房寶鑑之圖.
 [= *Tzu Yang Tan Fang Pao Chien Chih
 Thu*.]
 Precious Mirror of the Elixir and Enchy-
 moma Laboratory; Tables and Pictures
 (to illustrate the Principles).
 Sung, c. +1075.
 Chang Po-Tuan 張伯端 (Tzu Yang Tzu
 紫陽子 or Tzu Yang Chen Jen).
 Incorporated later in *Chin Tan Ta Yao Thu*
 (q.v.)
 In *Chin Tan Ta Yao* (*TTCY* ed.), ch. 3,
 pp. 34a ff. Also in *Wu Chen Phien* (in
Hsiu Chen Shih Shu, *TT/260*, ch. 26,
 pp. 5a ff.).
 Cf. Ho Ping-Yü & Needham (2).
- Tan I San Chüan* 丹擬三卷.
 See Pa Tzu-Yuan (1).
- Tan Lun Chüeh Chih Hsin Ching* 丹論訣旨心
 鑑 (*Chien* or *Chao* 鑑, 照 occur as tabu
 forms in the titles of some versions.)
 Mental Mirror Reflecting the Essentials of
 Oral Instruction about the Discourses on
 the Elixir and the Enchymoma.
 Thang, probably +9th.
 Chang Hsüan-Tê 張玄德, criticising the
 teachings of Ssuma Hsi-I 司馬希夷.
 TT/928, and in YCCC, ch. 66, pp. 1a ff.
 Tr. Sivin (5).
- Tan Thai Hsin Lu* 丹臺新錄.
 New Discourse on the Alchemical Laboratory.
 Early Sung or pre-Sung.
 Attrib. Chhing Hsia Tzu 青霞子 or
 Hsia Yu-Chang 夏有章.
 Extant only in quotations.
- Tan-Yang Chen Yen Yü Lu* 丹陽真人玉錄.
 Precious Records of the Adept Tan-Yang.
 Sung, mid +12th cent.
 Ma Yü 馬鈺.
 TT/1044.
- Tan-Yang Shen Kuang Tshan* 丹陽神光燦.
 Tan Yang (Tzu's Book) on the Resplen-
 dent Glow of the Numinous Light.
 Sung, mid +12th cent.
 Ma Yü 馬鈺.
 TT/1136.
- Tan Yao Pi Chüeh* 丹藥祕訣.
 Confidential Oral Instructions on Elixirs
 and Drugs.
 Prob. Yuan or early Ming.
 Hu Yen 胡演.
 Now only extant as quotations in the pharm-
 aceutical natural histories.

- Tao Fa Hsin Chhuan* 道法心傳.
Transmission of (a Lifetime of) Thought on Taoist Techniques [physiological alchemy with special reference to microcosm and macrocosm; many poems and a long exposition].
Yuan, +1294.
Wang Wei-I 王惟一.
TT/1235, and TTCY (*hsia mao chi*, 5).
- Tao Fa Hui Yuan* 道法會元.
Liturgical and Apotropaic Encyclopaedia of Taoism.
Thang and Sung.
Writers and compiler unknown.
TT/1203.
- Tao Hai Chin Liang* 道海津梁.
A Catena (of Words) to Bridge the Ocean of the Tao.
See Fu Chin-Chhuan (4).
- Tao Shu* 道樞.
Axial Principles of the Tao [doctrinal treatise, mainly on the techniques of physiological alchemy].
Sung, early +12th; finished by 1145.
Tsêng Tshao 曾慥.
TT/1005.
- Tao Su Fu* 摛素賦.
Ode on a Girl of Matchless Beauty [Chao nü, probably Chao Fei-Yen]; or, Of What does Spotless Beauty Consist?
C/Han, c. -20.
Pan chieh-yü 班婕妤.
In CSHK, Chhien Han Sect., ch. 11, p. 7a ff.
- Tao Tê Ching* 道德經.
Canon of the Tao and its Virtue.
Chou, before -300.
Attrib. Li Erh (Lao Tzu) 李耳(老子).
Tr. Waley (4); Chhu Ta-Kao (2); Lin Yü-Thang (1); Wiegner (7); Duyvendak (18); and very many others.
- Tao Tsang* 道藏.
The Taoist Patrology [containing 1464 Taoist works].
All periods, but first collected in the Thang about +730, then again about +870 and definitively in +1019. First printed in the Sung (+1111 to +1117). Also printed in J/Chin (+1168 to +1191), Yuan (+1244, +1607), and Ming (+1445, +1598 and Writers numerous.
Indexes by Wiegner (6), on which see Pelliot's review (58); and Ong 'Tu-Chien (Yin-Tê Index, no. 25).
- Tao Tsang Chi Yao* 道藏輯要.
Essentials of the Taoist Patrology [containing 287 books, 173 works from the Taoist Patrology and 114 Taoist works from other sources].
All periods, pr. 1906 at Erh-hsien-ssu 二仙寺, Chhêngtu.
Writers numerous.
- Ed. Ho Lung-Hsiang 賀龍驤 & Phêng Han-Jan 彭瀚然 (Chhing).
Tao Tsang Hsü Phien Chhu Chi 道藏續篇初集.
First Series of a Supplement to the Taoist Patrology.
Chhing, early 19th cent.
Edited by Min I-Tê 閔一得.
Tao Yin Yang Shêng Ching 導引養生經.
[= *Thai-Chhing Tao Yin Yang Shêng Ching*.]
Manual of Nourishing the Life-Force (or, Attaining Longevity and Immortality) by Gymnastics.
Late Thang, Wu 'Tai, or early Sung.
Writer unknown.
TT/811, and in YCCC, ch. 34.
Cf. Maspero (7), pp. 415 ff.
- Têng Chen Yin Chüeh* 登真隱訣.
Confidential Instructions for the Ascent to Perfected (Immortality).
Chin and S/Chhi. Original material from the neighbourhood of +365 to +366; commentary (the 'Confidential Instructions' of the title) by Thao Hung-Ching (+456 to +536) written between +493 and +498.
Original writer unknown.
Ed. Thao Hung-Ching 陶弘景.
TT/418, but conservation fragmentary.
Cf. Maspero (7), pp. 192, 374.
- Thai-Chhing Chen Jen Ta Tan* 太清真人太丹.
[Alternative later name of *Thai-Chhing Tan Ching Yao Chüeh*.]
The Great Elixirs of the Adepts; a Thai-Chhing Scripture.
Thang, mid +7th (c. +640).
Prob. Sun Ssu-Mo 孫思邈.
In YCCC, ch. 71.
Tr. Sivin (1), pp. 145 ff.
- Thai-Chhing Chin I Shen Chhi Ching* 太清金液神氣經.
Manual of the Numinous Chhi of Potable Gold; a Thai-Chhing Scripture.
Ch. 3 records visitations by the Lady Wei Hua-Tshun and her companion divinities mostly paralleling texts in the *Chen Kao*.
They were taken down by Hsü Mi's great-grandson Hsü Jung-Ti (d. +435), c. +430. Chs 1 and 2 are Thang or Sung, before +1150. If pre-Thang, cannot be earlier than +6th.
Writers mainly unknown.
TT/875.
- Thai-Chhing Chin I Shen Tan Ching* 太清金液神丹經.
Manual of the Potable Gold (or Metallous Fluid), and the Magical Elixir (or Enchymoma); a Thai-Chhing Scripture.
Date unknown, but must be pre-Liang (Chhen Kuo-Fu (1), vol. 2, p. 419). Contains dates between +320 and +330, but most of the prose is more probably of the early +5th century.

Thai-Chhing Chin I Shen Tan Ching (cont.)

Preface and main texts of *nei tan* character, all the rest *wai tan*, including laboratory instructions.

Writer unknown; chs. variously attributed.

The third chapter, devoted to descriptions of foreign countries which produced cinnabar and other chemical substances, may be of the second half of the +7th century (see Maspero (14), pp. 95 ff.). Most were based on Wan Chen's *Nan Chou I Wu Chih* (+3rd cent.), but not the one on the Roman Orient (Ta-Chhin) translated by Maspero. Stein (5) has pointed out however that the term *Fu-Lin* for Byzantium occurs as early as +500 to +520, so the third chapter may well be of the early +6th century.

TT/873.

Abridged in YCCC ch. 65, pp. 1 a ff.

Cf. Ho Ping-Yü (10).

Thai-Chhing Ching Thien-Shih Khou Chüeh

太清經天師口訣.

Oral Instructions from the Heavenly Masters [Taoist Patriarchs] on the Thai-Chhing Scriptures.

Date unknown, but must be after the mid +5th cent. and before Yuan.

Writer unknown.

TT/876.

Thai-Chhing Chung Huang Chen Ching 太清中

黃真經.

See *Chung Huang Chen Ching*.

Thai-Chhing Shih Pi Chi 太清石壁記.

The Records in the Rock Chamber (lit. Wall); a Thai-Chhing Scripture.

Liang, early +6th, but includes earlier work of Chin time as old as the late +3rd, attributed to Su Yuan-Ming.

Edited by Chhu Tsé hsien-sêng 楚澤先生.

Original writer, Su Yuan-Ming 蘇元明

(Chhing Hsia Tzu 青霞子).

TT/874.

Tr. Ho Ping-Yü (8).

Cf. *Lo-fou Shan Chih*, ch. 4, p. 13 a.

Thai-Chhing Tan Ching Yao Chüeh 太清丹經

要訣.

[= *Thai-Chhing Chen Jen Ta Tan*.]

Essentials of the Elixir Manuals, for Oral Transmission; a Thai-Chhing Scripture.

Thang, mid +7th (c. +640).

Prob. Sun Ssu-Mo 孫思邈.

In YCCC, ch. 71.

Tr. Sivin (1), pp. 145 ff.

Thai-Chhing Tao Yin Yang Shêng Ching 太清

導引養生經.

See *Tao Yin Yang Shêng Ching*.

Thai-Chhing Thiao Chhi Ching 太清調氣經.

Manual of the Harmonising of the Chhi; a

Thai-Chhing Scripture [breathing exercises for longevity and immortality].

Thang or Sung, +9th or +10th.

Writer unknown.

TT/813.

Cf. Maspero (7), p. 202.

Thai-Chhing (Wang Lao) (Fu Chhi) Khou Chüeh
(or *Chhuan Fa*) 太清王老服氣口訣
(傳法).

The Venerable Wang's Instructions for Absorbing the Chhi; a Thai-Chhing Scripture [Taoist breathing exercises].

Thang or Wu Tai (the name of Wang added in the +11th).

Writer unknown.

Part due to a woman Taoist, Li I 李液.

TT/815, and in YCCC, ch. 62, pp. 1 a ff.

and ch. 59, pp. 10 a ff.

Cf. Maspero (7), p. 209.

Thai-Chhing Yü Pei Tzu 太清玉碑子.

The Jade Stele (Inscription); a Thai-Chhing Scripture [dialogues between Chêng Yin and Ko Hung].

Date unknown, prob. late Sung or Yuan.

Writer unknown.

TT/920.

Cf. *Ta Tan Wên Ta* and *Chin Mu Wan Ling Lun*, which incorporate parallel passages.

Thai-Chi Chen-jen Chiu Chuan Huan Tan

Ching Yao Chüeh 太極真人九轉還丹經要訣.

Essential Teachings of the Manual of the Supreme-Pole Adept on the Ninefold Cyclically Transformed Elixir.

Date unknown, perhaps Sung on account of the pseudonym, but the Manual (*Ching*) itself may be pre-Sui because its title is in the *Sui Shu* bibliography. Mao Shan influence is revealed by an account of five kinds of magic plants or mushrooms that grow on Mt Mao, and instructions of Lord Mao for ingesting them.

Writer unknown.

TT/882.

Partial tr. Ho Ping-Yü (9).

Thai-Chi Chen-jen Tsa Tan Yao Fang 太極真人雜丹藥方.

Tractate of the Supreme-Pole Adept on Miscellaneous Elixir Recipes [with illustrations of alchemical apparatus].

Date unknown, but probably Sung on account of the philosophical significance of the pseudonym.

Writer unknown.

TT/939.

Thai-Chi Ko Hsien-Ong Chuan 太極葛仙翁傳.

Biography of the Supreme-Pole Elder-Immortal Ko (Hsüan).

Prob. Ming.

Than Ssu-Hsien 譚嗣先.

TT/447.

Thai Hsi Ching 胎息經.

Manual of Embryonic Respiration.

Thang, +8th, c. +755.

- Thai Hsi Ching (cont.)*
 Huan Chen hsien-sêng 幻真先生
 (Mr Truth-and-Illusion).
 TT/127, and YCCC, ch. 60, pp. 22b ff.
 Tr. Balfour (1).
 Cf. Maspero (7), p. 211.
- Thai Hsi Ching Wei Lun* 胎息精微論.
 Discourse on Embryonic Respiration and
 the Subtlety of the Seminal Essence.
 Thang or Sung.
 Writer unknown.
 In YCCC, ch. 58, pp. 1a ff.
 Cf. Maspero (7), p. 210.
- Thai Hsi Kên Chih Yao Chüeh* 胎息根旨要訣.
 Instruction on the Essentials of (Under-
 standing) Embryonic Respiration [Taoist
 respiratory and sexual techniques].
 Thang or Sung.
 Writer unknown.
 In YCCC, ch. 58, pp. 4b ff.
 Cf. Maspero (7), p. 380.
- Thai Hsi Khou Chüeh* 胎息口訣.
 Oral Explanation of Embryonic Respiration.
 Thang or Sung.
 Writer unknown.
 In YCCC, ch. 58, pp. 12a ff.
 Cf. Maspero (7), p. 198.
- Thai Hsi Shui Fa* 泰西水法.
 Hydraulic Machinery of the West.
 Ming, +1612.
 Hsiung San-Pa (Sabatino de Ursis) 熊三拔
 & Hsü Kuang-Chih 徐光啓.
- Thai Hsüan Pao Tien* 太玄寶典.
 Precious Records of the Great Mystery [of
 attaining longevity and immortality by
 physiological alchemy, *nei tan*].
 Sung or Yuan, +13th or +14th.
 Writer unknown.
 TT/1022, and in TTCY (*shang mao chi*, 5).
- Thai-I Chin Hua Tsung Chih* 太一(或乙)金華
 宗旨.
 Principles of the (Inner) Radiance of the
 Metallous (Enchymoma), (explained in
 terms of the) Undifferentiated Universe.
 See *Chin Hua Tsung Chih*.
- Thai-Ku Chi* 太古集.
 Collected Works of (Ho) Thai-Ku [Ho Ta-
 Thung].
 Sung, c. +1200.
 Ho Ta-Thung 郝大通.
 TT/1147.
- Thai Ku Thu Tui Ching* 太古土兌經.
 Most Ancient Canon of the Joy of the Earth;
 or, of the Element Earth and the Kua
 Tui [mainly on the alchemical sub-
 duing of metals and minerals].
 Date unknown, perhaps Thang or slightly
 earlier.
 Attrib. Chang hsien-sêng 張先生.
 TT/942.
- Thai Pai Ching* 太白經.
 The Venus Canon.
 Thang, c. +800.
 Shih Chien-Wu 施肩吾.
 TT/927.
- Thai Phing Ching* 太平經.
 [= *Thai Phing Ching Ling Shu*.]
 Canon of the Great Peace (and Equality).
 Ascr. H/Han, c. +150 (first mentioned
 +166) but with later additions and inter-
 polations.
 Part attrib. Yü Chi 于吉.
 Perhaps based on the *Thien Kuan Li Pao*
Yuan Thai Phing Ching (c. -35) of Kan
 Chung-Kho 甘忠可.
 TT/1087. Reconstructed text, ed. Wang
 Ming (2).
 Cf. Yü Ying-Shih (2), p. 84.
 According to Hsiung Tê-Chi (1) the parts
 which consist of dialogue between a
 Heavenly Teacher and a disciple cor-
 respond with what the *Pao Phu Tzu*
 bibliography lists as *Thai Phing Ching*
 and were composed by Hsiang Khai
 襄楷.
 The other parts would be for the most part
 fragments of the *Chia I Ching* 甲乙經,
 also mentioned in *Pao Phu Tzu*, and due
 to Yü Chi and his disciple Kung Chhung
 宮崇 between +125 and +145.
- Thai Phing Ching Ling Shu* 太平清領書.
 Received Book of the Great Peace and
 Purity.
 See *Thai Phing Ching*.
- Thai-Phing Huan Yü Chi* 太平寰宇記.
 Thai-Phing reign-period General Descrip-
 tion of the World [geographical record].
 Sung, +976 to +983.
 Yüeh Shih 樂史.
- Thai-Phing Hui Min Ho Chi Chü Fang* 太平惠
 民和劑局方.
 Standard Formularies of the (Government)
 Great Peace People's Welfare Pharmacies
 [based on the *Ho Chi Chü Fang*, etc.].
 Sung, +1151.
 Ed. Chhen Shih-Wên 陳師文, Phei
 Tsung-Yuan 裴完元, and Chhen
 Chhêng 陳承.
 Cf. Li Thao (1, 6); SIC, p. 973.
- Thai-Phing Kuang Chi* 太平廣記.
 Copious Records collected in the Thai-
 Phing reign-period [anecdotes, stories,
 mirabilia and memorabilia].
 Sung, +978.
 Ed. Li Fang 李昉.
- Thai-Phing Shêng Hui Fang* 太平聖惠方.
 Prescriptions Collected by Imperial
 Benevolence during the Thai-Phing
 reign-period.
 Sung, commissioned +982; completed
 +992.
 Ed. Wang Huai-Yin 王懷隱, Chêng Yen
 鄭彥 et al.
 SIC, p. 921; Yü Hai, ch. 63.

- Thai-Phing Yü Lan* 太平御覽.
Thai-Phing reign-period Imperial Encyclopaedia (lit. the Emperor's Daily Readings).
Sung, +983.
Ed. Li Fang 李昉.
Some chs. tr. Pfizmaier (84-106).
Yin-Tê Index, no. 23.
- Thai-Shang Chu Kuo Chiu Min Tsung Chen Pi Yao* 太上助國救民總真秘要.
Arcane Essentials of the Mainstream of Taoism, for the Help of the Nation and the Saving of the People; a Thai-Shang Scripture [apotropaics and liturgy].
Sung, +1016.
Yuan Miao-Tsung 元妙宗.
TT/1210.
- Thai-Shang Chuan Hsi Wang Mu Wo Ku Fa* 太上傳西王母握固法.
See *Chuan Hsi Wang Mu Wo Ku Fa*.
- Thai-Shang Huang Thing Nei* (or *Wai* or *Chung*) *Ching* (Yü) *Ching* 太上黃庭內(外,中)景(玉)經.
See *Huang Thing*, etc.
- Thai-Shang Lao Chün Yang Shêng Chüeh* 太上老君養生訣.
Oral Instructions of Lao Tzu on Nourishing the Life-Force; a Thai-Shang Scripture [Taoist respiratory and gymnastic exercises].
Thang.
Attrib. Hua Tho 華佗 and Wu Phu 吳普.
Actual writer unknown.
TT/814.
- Thai-Shang Ling-Pao Chih Tshao Thu* 太上靈寶芝草圖.
Illustrations of the Numinous Mushrooms; a Thai-Shang Ling-Pao Scripture.
Sui or pre-Sui.
Writer unknown.
TT/1387.
- Thai-Shang Ling-Pao Wu Fu* (Ching) 太上靈寶五符(經).
(Manual of) the Five Categories of Formulae (for achieving Material and Celestial Immortality); a Thai-Shang Ling-Pao Scripture [liturgical].
San Kuo, mid +3rd.
Writers unknown.
TT/385.
On the term Ling-Pao see Kaltenmark (4).
- Thai-Shang Pa-Ching Ssu-jui Tzu-Chiang* (Wu-Chu) *Chiang-Shêng Shen Tan Fang* 太上八景四靈紫籙(五珠)降生神丹方.
Method for making the Eight-Radiances Four-Stamens Purple-Fluid (Five-Pearl) Incarnate Numinous Elixir; a Thai-Shang Scripture.
Chin, probably late +4th.
Putatively dictated to Yang Hsi 楊羲.
In YCCC, ch. 68; another version in TT/1357.
- Thai-Shang Pa Ti Yuan* (Hsüan) *Pien Ching* 太上八帝元(玄)變經.
See *Tung-Shen Pa Ti Yuan* (Hsüan) *Pien Ching*.
- Thai Shang-San-shih-liu pu Tsun Ching* 太上三十六部尊經.
The Venerable Scripture in 36 Sections.
TT/8.
See *Shang Ching Ching*.
- Thai-Shang Tung Fang Nei Ching Chu* 太上洞房內經注.
Esoteric Manual of the Innermost Chamber, a Thai-Shang Scripture; with Commentary.
Ascr. - 1st cent.
Attrib. Chou Chi-Thung 周季通.
TT/130.
- Thai-Shang Tung-Hsüan Ling-Pao Mieh Tu* (or *San Yuan*) *Wu Lien Shêng Shih Miao Ching* 太上洞玄靈寶滅度(或三元)五鍊生尸妙經.
Marvellous Manual of the Resurrection (or Preservation) of the Body, giving Salvation from Dispersal, by means of (the Three Primary Vitalities and) the Five Transmutations; a Ling-Pao Thai-Shang Tung-Hsüan Scripture.
Date uncertain.
Writer unknown.
TT/366.
- Thai-Shang Tung-Hsüan Ling-Pao Shou Tu I* 太上洞玄靈寶授度儀.
Formulae for the Reception of Salvation; a Thai-Shang Tung-Hsüan Ling-Pao Scripture [liturgical].
L/Sung, c. +450.
Lu Hsiu-Ching 陸修靜.
TT/524.
- Thai-Shang Wei Ling Shen Hua Chiu Chuan Tan Sha Fa* 太上衛靈神化九轉丹砂法.
Methods of the Guardian of the Mysteries for the Marvellous Thaumaturgical Transmutation of Ninefold Cyclically Transformed Cinnabar; a Thai-Shang Scripture.
Sung, if not earlier.
Writer unknown.
TT/885.
Tr. Spooner & Wang (1); Sivin (3).
- Thai-Shang Yang Shêng Thai Hsi Chhi Ching* 太上養生胎息氣經.
See *Yang Shêng Thai Hsi Chhi Ching*.
- Thai Tsang Lun* 胎藏論.
Discourse on the Foetalisation of the Viscera (the Restoration of the Embryonic Condition of Youth and Health).
Alternative title of *Chung Huang Chen Ching* (q.v.).
- Thai-Wei Ling Shu Tzu-Wên Lang-Kan Hua Tan Shen Chen Shang Ching* 太微靈書紫文琅玕華神真上經.

- Thai-Wei Ling Shu Tzu-Wên Lang-Kan Hua Tan Shen Chen Shang Ching* (cont.)
Divinely Written Exalted Spiritual Realisation Manual in Purple Script on the Lang-Kan (Gem) Radiant Elixir; a Thai-Wei Scripture.
Chin, late +4th century, possibly altered later.
Dictated to Yang Hsi 楊羲.
TT/252.
- Thai-Wu hsien-sêng Fu Chhi Fa* 太无先生服氣法.
See *Sung Shan Thai-Wu hsien-sêng Chhi Ching*.
- Than hsien-sêng Shui Yün Chi* 譚先生水雲集.
Mr Than's Records of Life among the Mountain Clouds and Waterfalls.
Sung, mid +12th cent.
Than Chhu-Tuan 譚處端.
TT/1146.
- Thang Hui Yao* 唐會要.
History of the Administrative Statutes of the Tang Dynasty.
Sung, +961.
Wang Phu 王溥.
Cf. des Rotours (2), p. 92.
- Thang Liu Tien* 唐六典.
Institutes of the Tang Dynasty (lit. Administrative Regulations of the Six Ministries of the Tang).
Tang, +738 or +739.
Ed. Li Lin-Fu 李林甫.
Cf. des Rotours (2), p. 99.
- Thang Pên Tshao* 唐本草.
Pharmacopoeia of the Tang Dynasty.
= *Hsin Hsiu Pên Tshao*, (q.v.).
- Thang Yü Lin* 唐語林.
Miscellanea of the Tang Dynasty.
Sung, collected c. +1107.
Wang Tang 王彙.
Cf. des Rotours (2), p. 109.
- Thao Chen Jen Nei Tan Fu* 陶真人內丹賦.
See *Nei Tan Fu*.
- Thi Kho Ko* 體殼歌.
Song of the Bodily Husk (and the Deliverance from its Ageing).
Wu Tai or Sung, in any case before +1040
Yen Lo Tzu (ps.) 堙羅子.
In *Hsiu Chen Shih Shu* (TT/260), ch. 18.
- Thiao Chhi Ching* 調氣經.
See *Thai-Ching Thiao Chhi Ching*.
- Thieh Wei Shan Tshung Than* 鐵圍山叢談.
Collected Conversations at Iron-Fence Mountain.
Sung, c. +1115.
Tshai Thao 蔡條.
- Thien-Hsia Chün Kuo Li Ping Shu* 天下郡國利病書.
Merits and Drawbacks of all the Countries in the World [geography].
Ching, +1662.
Ku Yen-Wu 顧炎武.
- Thien Hsien Chêng Li Tu 'Fa Tien Ching'* 天仙正理讀法點睛.
The Right Pattern of the Celestial Immortals; Thoughts on Reading the *Consecration of the Law*.
See *Fu Chin-Chhüan* (2).
- Thien Hsien Chih Lun Chhang Shêng Tu Shih Nei Lien Chin Tan* (Chüeh Hsin) *Fa* 天仙直論長生度世內煉金丹(訣心)法.
(Confidential) Methods for Processing the Metallous Encyhmoma; a Plain Discourse on Longevity and Immortality (according to the Principles of the) Celestial Immortals for the Salvation of the World.
Alternative title for *Nei Chin Tan* (q.v.).
- Thien Kung Khai Wu* 天工開物.
The Exploitation of the Works of Nature.
Ming, +1637.
Sung Ying-Hsing 宋應星.
Tr. Sun Jen I-Tu & Sun Hsiieh-Chuan (1).
- Thien-thai Shan Fang Wai Chih* 天臺山方外志.
Supplementary Historical Topography of Thien-thai Shan.
Ming.
Chhuan-Têng (monk) 傳燈.
- Thien Ti Yin-Yang Ta Lo Fu* 天地陰陽大樂賦.
Poetical Essay on the Supreme Joy.
Tang, c. +800.
Pai Hsing-Chien 白行簡.
- Thien Yuan Ju Yao Ching* 天元入藥鏡.
Mirror of the All-Penetrating Medicine (the Enchymoma; restoring the Endowment) of the Primary Vitalities.
Wu Tai, +940.
Tshui Hsi-Fan 崔希範.
In *Hsiu Chen Shih Shu* (TT/260), ch. 21, pp. 6b to 9b; a prose text without commentary, not the same as the *Ju Yao Ching* (q.v.) and ending with a diagram absent from the latter.
Cf. van Gulik (8), pp. 224 ff.
- Tho Yo Tzu* 橐籥子.
Book of the Bellows-and-Tuyère Master [physiological alchemy in mutationist terms].
Sung or Yuan.
Writer unknown.
TT/1174, and *TTCY* (*hsin mao chi*, 5).
- Thou Huang Tsa Lu* 投荒雜錄.
Miscellaneous Jottings far from Home.
Tang, c. +835.
Fang Chhien-Li 房千里.
- Thu Ching* (Pên Tshao) 圖經(本草).
Illustrated Treatise (of Pharmaceutical Natural History). See *Pên Tshao Thu Ching*.
The term *Thu Ching* applied originally to one of the two illustrated parts (the other being a *Yao Thu*) of the *Hsin Hsiu Pên*

- Thu Ching (Pên Tshao) (cont.)*
Tshao of +659 (q.v.); cf. *Hsin Thang Shu*, ch. 59, p. 21a or *TSCCIW*, p. 273. By the middle of the +11th century these had become lost, so Su Sung's *Pên Tshao Thu Ching* was prepared as a replacement. The name *Thu Ching Pên Tshao* was often afterwards applied to Su Sung's work, but (according to the evidence of the *Sung Shih* bibliographies, *SSIW*, pp. 179, 529) wrongly.
- Thu Ching Chi-Chu Yen I Pên Tshao* 圖經集注衍義本草.
 Illustrations and Collected Commentaries for the *Dilations upon Pharmaceutical Natural History*.
 TT/761 (Ong index, no. 767).
 See also *Thu Ching Yen I Pên Tshao*.
 The *Tao Tsang* contains two separately catalogued books, but the *Thu Ching Chi-Chu Yen I Pên Tshao* is in fact the introductory 5 chapters, and the *Thu Ching Yen I Pên Tshao* the remaining 42 chapters of a single work.
- Thu Ching Yen I Pên Tshao* 圖經衍義本草.
 Illustrations (and Commentary) for the *Dilations upon Pharmaceutical Natural History*. (An abridged conflation of the *Chêng-Ho... Chêng Lei... Pên Tshao* with the *Pên Tshao Yen I*).
 Sung, c. +1223.
 Thang Shen-Wei 唐愼微, Khou Tsung-Shih 寇宗奭, ed. Hsü Hung 許洪.
 TT/761 (Ong index, no. 768).
 See also *Thu Ching Chi-Chu Yen I Pên Tshao*.
 Cf. Chang Tsan-Chhen (2); Lung Po-Chien (1), nos. 38, 39.
- Thu Hsiu Chen Chün Tsao-Hua Chih Nan* 土宿眞君造化指南.
 Guide to the Creation, by the Earth's Mansions Immortal.
 See *Tsao-Hua Chih Nan*.
- Thu Hsiu Pên Tshao* 土宿本草.
 The Earth's Mansions Pharmacopoeia.
 See *Tsao-Hua Chih Nan*.
- Thung Hsüan Pi Shu* 通玄秘術.
 The Secret Art of Penetrating the Mystery [alchemy].
 Thang, soon after +864.
 Shen Chih-Yen 沈知言.
 TT/935.
- Thung Su Pien* 通俗編.
 Thesaurus of Popular Terms, Ideas and Customs.
 Chhing, +1751.
 Tsé Hao 翟灝.
- Thung Ya* 通雅.
 Helps to the Understanding of the *Literary Expositor* [general encyclopaedia with much of scientific and technological interest].
 Ming and Chhing, finished +1636, pr. +1666.
 Fang I-Chih 方以智.
- Thung Yu Chüeh* 通幽訣.
 Lectures on the Understanding of the Obscurity (of Nature) [alchemy, proto-chemical and physiological].
 Not earlier than Thang.
 Writer unknown.
 TT/906.
 Cf. Chhen Kuo-Fu (1), vol. 2, p. 390.
- Tien Hai Yü Hêng Chih* 滇海虞衡志.
 A Guide to the Region of the Kunming Lake (Yunnan).
 Chhing, c. +1770, pr. +1799.
 Than Tshui 檀萃.
- Tien Shu* 典術.
 Book of Arts.
 L/Sung.
 Wang Chien-Phing 王建平.
- Ting Chhi Ko* 鼎器歌.
 Song (or, Mnemonic Rhymes) on the (Alchemical) Reaction-Vessel.
 Han, if indeed originally, as it is now, a chapter of the *Chou I Tshan Thung Chhi* (q.v.).
 It has sometimes circulated separately.
 In *Chou I Tshan Thung Chhi Fên Chang Chu Chieh*, ch. 33 (ch. 3, pp. 7a ff.).
 Cf. *Chou I Tshan Thung Chhi Ting Chhi Ko Ming Ching Thu* (TT/994).
- Ton Isho* 頓醫抄.
 Medical Excerpts Urgently Copied.
 Japan, +1304.
 Kajiwara Shozen 梶原性全.
- Tongüi Pogam* 東醫寶鑑.
 See *Tung I Pao Chien*.
- Tou hsien-sêng Hsiu Chen Chih Nan* 饒先生修真指南.
 See *Hsi Yo Tou hsien-sêng Hsiu Chen Chih Nan*.
- Tsao Hua Chhien Chhui* 造化鉗鎚.
 The Hammer and Tongs of Creation (i.e. Nature).
 Ming, c. +1430.
 Chu Chhüan 朱權.
 (Ning Hsien Wang 寧獻王, prince of the Ming.)
- Tsao-Hua Chih Nan* 造化指南.
 [= *Thu Hsiu Pên Tshao*.]
 Guide to the Creation (i.e. Nature).
 Thang, Sung or possibly Ming. A date about +1040 may be the best guess, as there are similarities with the *Wai Tan Pên Tshao* (q.v.).
 Thu Hsiu Chen Chün 土宿眞君 (the Earth's Mansions Immortal).
 Preserved only in quotation, as in *PTKM*.
- Tsê Ko Lu* 則克錄.
 Methods of Victory.
 Title, in certain editions, of the *Huo Kung Chieh Yao* (q.v.).

- Tseng Kuang Chih Nang Pu* 增廣智囊補.
Additions to the *Enlarged Bag of Wisdom*
Supplemented.
Ming, c. +1620.
Feng Meng-Lung 馮夢龍.
Tshai Chen Chi Yao 採真機要.
Important (Information on the) Means (by
which one can) Attain (the) Regeneration
of the) Primary (Vitalities) [physiological
alchemy, poems and commentary].
Part of *San-Feng Tan Chueh* (q.v.).
Tshan Thung Chhi 參同契.
The Kinship of the Three; or, The Accord-
dance (of the *Book of Changes*) with the
Phenomena of Composite Things
[alchemy].
H/Han, +142.
Wei Po-Yang 魏伯陽.
Tshan Thung Chhi.
See also titles under *Chou I Tshan Thung*
Chhi.
Tshan Thung Chhi Chang Chü 參同契章句.
The Kinship of the Three (arranged in)
Chapters and Sections.
Chhing, +1717.
Ed. Li Kuang-Ti 李光地.
Tshan Thung Chhi Khao I 參同契考異.
[=*Chou I Tshan Thung Chhi Chu*.]
A Study of the Kinship of the Three.
Sung, +1197.
Chu Hsi 朱熹 (originally using pseudonym
Tsou Hsin 鄒訢).
TT/992.
Tshan Thung Chhi Shan Yu 參同契闡幽.
Explanation of the Obscurities in the Kin-
ship of the Three.
Chhing, pref. +1729, pr. +1735.
Ed and comm. Chu Yuan-Yü 朱元育.
TTCY.
Tshan Thung Chhi Wu Hsiang Lei Pi Yao 參同
契五相類秘要.
Arcane Essentials of the Similarities and
Categories of the Five (Substances) in the
Kinship of the Three (sulphur, realgar,
orpiment, mercury and lead).
Liu Chhao, possibly Thang; prob. between
+3rd and +7th cents., must be before
the beginning of the +9th cent., though
ascr. +2nd.
Writer unknown (attrib. Wei Po-Yang).
Comm. by Lu Thien-Chi 盧天賦, wr.
Sung, +1111 to +1117, probably +1114.
TT/898.
Tr. Ho Ping-Yü & Needham (2).
Tshao Mu Tzu 草木子.
The Book of the Fading-like-Grass Master.
Ming, +1378.
Yeh Tzu-Chhi 葉子奇.
Tshê Fu Yuan Kuei 冊府元龜.
Collection of Material on the Lives of
Emperors and Ministers, (lit. (Lessons of)
the Archives, (the True) Scapulimancy);
[a governmental ethical and political
encyclopaedia].
Sung, commissioned +1005, pr. +1013.
Ed. Wang Chhin-Jo 王欽若 & Yang I
楊億.
Cf. des Rotours (2), p. 91.
Tshui Hsiu Phien 翠虛篇.
Book of the Emerald Heaven.
Sung, c. +1200.
Chhen Nan 陳楠.
TT/1076.
Tshui Kung Yu Yao Ching Chu (or *Ho*) Chieh
崔公入藥鏡註(合)解.
See *Yu Yao Ching* and *Thien Yuan Yu Yao*
Ching.
Tshun Chen Huan Chung Thu 存真環中圖.
Illustrations of the True Form (of the Body)
and of the (Tracts of) Circulation (of the
Chhi).
Sung, +1113.
Yang Chieh 楊介.
Now partially preserved only in the *Ton-
Isho* and the *Man-Anpô* (q.v.). Some of
the drawings are in Chu Hung's *Nei*
Wai Erh Ching Thu, also in *Hua Tho*
Nei Chao Thu and *Kuang Wei Ta Fa*
(q.v.).
Tshun Fu Chai Wên Chi 存復齋文集.
Literary Collection of the Preservation-and-
Return Studio.
Yuan, +1349.
Chu Tê-Jun 朱德潤.
Tso Chuan 左傳.
Master Tso chhiu's Tradition (or Enlarge-
ment) of the *Chhun Chhiu* (*Spring and*
Autumn Annals), [dealing with the period
-722 to -453].
Late Chou, compiled from ancient written
and oral traditions of several States be-
tween -430 and -250, but with addi-
tions and changes by Confucian scholars
of the Chhin and Han, especially Liu
Hsin. Greatest of the three commen-
taries on the *Chhun Chhiu*, the others
being the *Kungyang Chuan* and the
Kuliang Chuan, but unlike them, prob-
ably originally itself an independent book
of history.
Attrib. Tsochhiu Ming 左邱明.
See Karlgren (8); Maspero (1); Chhi Ssu-
Ho (1); Wu Khang (1); Wu Shih-
Chhang (1); van der Loon (1); Eberhard,
Müller & Henseling (1).
Tr. Couvreur (1); Legge (11); Pfizmaier
(1-12).
Index by Fraser & Lockhart (1).
Tso Wang Lun 坐忘論.
Discourse on (Taoist) Meditation.
Thang, c. +715.
Ssuma Chhêng-Chên 司馬承貞.
TT/1024, and in *TTCY* (*shang mao chi*,
5).

- Tsui Shang I Chheng Hui Ming Ching* 最上一乘慧命經.
Exalted Single-Vehicle Manual of the Sagacious (Lengthening of the) Life-Span.
See *Hui Ming Ching*.
Tsun Sheng Pa Chien 遵生八牋.
Eight Disquisitions on Putting Oneself in Accord with the Life-Force [a collection of works].
Ming, +1591.
Kao Lien 高謙.
For the separate parts see:
1. *Chhing Hsiu Miao Lun Chien* (chs. 1, 2).
2. *Ssu Shih Thiao Shē Chien* (chs. 3-6).
3. *Chhi Chū An Lo Chien* (chs. 7, 8).
4. *Yen Nien Chhio Ping Chien* (chs. 9, 10).
5. *Yin Chuan Fu Shih Chien* (chs. 11-13).
6. *Yen Hsien Chhing Shang Chien* (chs. 14, 15).
7. *Ling Pi Tan Yao Chien* (chs. 16-18).
8. *Lu Wai Hsia Chū Chien* (ch. 19).
Tsurezuregusa 徒然草.
Gleanings of Leisure Moments [miscellaneous, with much on Confucianism, Buddhism and Taoist philosophy].
Japan, +1338.
Kenkō hōshi 兼好法師 (Yoshida no Kaneyoshi 吉田兼好).
Cf. Anon. (103), pp. 197 ff.
Tu Hsing Tsa Chih 獨醒雜志.
Miscellaneous Records of the Lone Watcher.
Sung, +1176.
Tseng Min-Hsing 曾敏行.
Tu I Chih 獨異志.
Things Uniquely Strange.
Thang.
Li Jung 李冗 (or 冗).
Tu Jen Ching 度人經.
See *Ling-Pao Wu Liang Tu Jen Shang Phin Miao Ching*.
Tu Shih Fang Yü Chi Yao 讀史方輿紀要.
Essentials of Historical Geography.
Chhing, first pr. +1667, greatly enlarged before the author's death in +1692, and pr. c. +1799.
Ku Tsu-Yü 顧祖禹.
Tung-Chen Ling Shu Tzu-Wên Lang-Kan Hua Tan Shang Ching 洞真靈書紫文琅玕華丹上經.
Divinely Written Exalted Manual in Purple Script on the Lang-Kan (Gem) Radiant Elixir; a Tung-Chen Scripture.
Alternative name of *Thai-Wei Ling Shu Tzu-Wên Lang-Kan Hua Tan Shen Chen Shang Ching* (q.v.).
Tung-Chen Thai-Shang Su-Ling Tung-Yuan Ta Yu Miao Ching 洞真太上素靈洞元大有妙經.
See *Ta Yu Miao Ching*.
Tung-Chen Thai-Wei Ling Shu Tzu-Wên Shang Ching 洞真太微靈書紫文上經.
Divinely Written Exalted Canon in Purple Script; a Tung-Chen Thai-Wei Scripture.
See *Thai-Wei Ling Shu Tzu-Wên Lang-Kan Hua Tan Shen Chen Shang Ching*, which it formerly contained.
Tung Hsien Pi Lu 東軒筆錄.
Jottings from the Eastern Side-Hall.
Sung, end +11th.
Wei Thai 魏泰.
Tung-Hsüan Chin Yü Chi 洞玄金玉集.
Collections of Gold and Jade; a Tung-Hsüan Scripture.
Sung, mid +12th cent.
Ma Yü 馬鈺.
TT/1135.
Tung-Hsüan Ling-Pao Chen Ling Wei Yeh Thu 洞玄靈寶真靈位業圖.
Charts of the Ranks, Positions and Attributes of the Perfected (Immortals); a Tung-Hsüan Ling-Pao Scripture.
Ascr. Liang, early +6th.
Attrib. Thao Hung-Ching 陶弘景.
TT/164.
Tung Hsüan Tzu 洞玄子.
Book of the Mystery-Penetrating Master.
Pre-Thang, perhaps +5th century.
Writer unknown.
In *Shuang Mei Ching An Tshung Shu*.
Tr van Gulik (3).
Tung I Pao Ching 東醫寶鑑.
Precious Mirror of Eastern Medicine [system of medicine].
Korea, commissioned in +1596, presented +1610, printed +1613.
Hō Chun 許浚.
Tung-Pho Shih Chi Chu 東坡詩集注.
[= *Mei-Chhi Shih Chu*.]
Collected Commentaries on the Poems of (Su) Tung-Pho.
Sung, c. +1140.
Wang Shih-Phêng 王十朋 (i.e. Wang Mei-Chhi 王梅溪).
Tung Shen Ching 洞神經.
See *Tung Shen Pa Ti Miao Ching Ching* and *Tung Shen Pa Ti Yuan Pien Ching*.
Tung Shen Pa Ti Miao Ching Ching 洞神八帝妙精經.
Mysterious Canon of Revelation of the Eight (Celestial) Emperors; a Tung-Shen Scripture.
Date uncertain, perhaps Thang but more probably earlier.
Writer unknown.
TT/635.
Tung Shen Pa Ti Yuan (Hsüan) Pien Ching 洞神八帝元(玄)變經.
Manual of the Mysterious Transformations of the Eight (Celestial) Emperors; a Tung-Shen Scripture [nomenclature of

- Tung Shen Pa Ti Yuan (Hsüan) Pien Ching*
(cont.)
spiritual beings, invocations, exorcisms,
techniques of rapport].
Date uncertain, perhaps Thang but more
probably earlier.
Writer unknown.
TT/1187.
- Tzu Chin Kuang Yao Ta Hsien Hsiu Chen Yen I*
紫金光耀大仙修真演義.
See *Hsiu Chen Yen I*.
- Tzu-jan Chi* 自然集.
Collected (Poems) on the Spontaneity of
Nature.
Sung, mid + 12th cent.
Ma Yü 馬鈺.
TT/1130.
- Tzu-Yang Chen Jen Nei Chuan* 紫陽真人內傳.
Biography of the Adept of the Purple Yang.
H/Han, San Kuo or Chin, before + 399.
Writer unknown.
This Tzu-Yang Chen Jen was Chou I-Shan
周義山 (not to be confused with Chang
Po-Tuan).
Cf. Maspero (7), p. 201; (13), pp. 78, 103.
TT/300.
- Tzu-Yang Chen Jen Wu Chen Phien* 紫陽真人
悟真篇.
See *Wu Chen Phien*.
- Tzu Tan Fang Pao Chien Chih Thu* 紫陽
丹房寶鑑之圖.
See *Tan Fang Pao Chien Chih Thu*.
- Wai Chin Tan* 外金丹.
Disclosures (of the Nature of) the Metallous
Enchymoma [a collection of some thirty
tractates on *nei tan* physiological alchemy,
ranging in date from Sung to Chhing and
of varying authenticity].
Sung to Chhing.
Ed. Fu Chin-Chhüan 傅金銓, c. 1830.
In *CTPS*, pên 6-10 incl.
- Wai Kho Chêng Tsung* 外科正宗.
An Orthodox Manual of External Medicine.
Ming, +1617.
Chhen Shih-Kung 陳實功.
See *Wu Shih Wai Kuo Chuan*.
- Wai Tan Pên Tshao* 外丹本草.
Iatrochemical Natural History.
Early Sung, c. +1045.
Tshui Fang 崔昉.
Now extant only in quotations.
Cf. *Chin Tan Ta Yao Pao Chüeh* and *Ta
Tan Yao Chüeh Pên Tshao*.
- Wai Thai Pi Yao (Fang)* 外臺秘要(方).
Important (Medical) Formulae and Pre-
scriptions now revealed by the Governor
of a Distant Province.
Thang, +752.
Wang Thao 王濤.
On the title see des Rotours (1), pp. 294,
721. Wang Thao had had access to the
books in the Imperial Library as an
Academician before his posting as a high
official to the provinces.
- Wakan Sanzai Zue* 和漢三才圖會.
The Chinese and Japanese Universal
Encyclopaedia (based on the *San Tshai
Thu Hui*).
Japan, +1712.
Terashima Ryōan 寺島良安.
Wamyō-Honzō. See *Honzō-Wamyō*.
Wamyō Ruijushō 和(或倭)名類聚抄.
General Encyclopaedic Dictionary.
Japan (Heian), +934.
Minamoto no Shitagau 源順.
Wamyōshō 和名抄.
See *Wamyō Ruijushō*.
- Wan Hsing Thung Phu* 萬姓統譜.
General Dictionary of Biography.
Ming, +1579.
Ling Ti-Chih 凌迪知.
- Wan Ping Hui Chhun* 萬病回春.
The Restoration of Well-Being from a
Myriad Diseases.
Ming, +1587, pr. +1615.
Kung Thing-Hsien 龔廷賢.
- Wan Shou Hsien Shu* 萬壽仙書.
A Book on the Longevity of the Immortals
[longevity techniques, especially gym-
nastics and respiratory exercises].
Chhing, +18th.
Tshao Wu-Chi 曹無極.
Included in *Pa Tzu-Yuan* (1).
- Wang Hsien Fu* 望仙賦.
Contemplating the Immortals; a Hymn of
Praise [ode on Wangtzu Chhiao and
Chhieh Sung Tzu].
C/Han, -14 or -13.
Huan Than 桓譚.
In *C.S.H.K.* (Hou Han sect.), ch. 12, p. 7b;
and several encyclopaedias.
- Wang Lao Fu Chhi Khou Chüeh* 王老服氣口
訣.
See *Thai-Chhing Wang Lao Fu Chhi Khou
Chüeh*.
- Wang-Wu Chen-jen Khou Shou Yin Tan Pi*
Chüeh Ling Phien 王屋真人口授陰丹
秘訣靈篇.
Numinous Record of the Confidential Oral
Instructions on the Yin Enchymoma
handed down by the Adept of Wang-Wu
(Shan).
Thang, perhaps c. +765; certainly between
+8th and late +10th.
Probably Liu Shou 劉守.
In *YCCC*, ch. 64, pp. 13a ff.
- Wang-Wu Chen-jen Liu Shou I Chen-jen Khou*
Chüeh Chin Shang 王屋真人劉守依真
人口訣進上.
Confidential Oral Instructions of the Adept
of Wang-Wu (Shan) presented to the
Court by Liu Shou.

- Wang-Wu Chen-Jen Liu Shou I Chen-Jen Khou Chüeh Chin Shang* (cont.)
Thang, c. +785 (after +780); certainly between +8th and late +10th.
Liu Shou 劉守.
In YCCC, ch. 64, pp. 14a ff.
- Wei Lüeh* 緯略.
Compendium of Non-Classical Matters.
Sung, +12th century (end), c. +1190.
Kao Ssu-Sun 高似孫.
- Wei Po-Yang Chhi Fan Tan Sha Chüeh.*
See *Chhi Fan Tan Sha Chüeh*.
- Wei Shêng I Chin Ching* 衛生易筋經.
See *I Chin Ching*.
- Wei Shu* 魏書.
History of the (Northern) Wei Dynasty [+386 to +550, including the Eastern Wei successor State].
N/Chhi, +554, revised +572.
Wei Shou 魏收.
See Ware (3).
One ch. tr. Ware (1, 4).
For translations of passages, see the index of Frankel (1).
- Wên Shih Chen Ching* 文始真經.
True Classic of the Original Word (of Lao Chün, third person of the Taoist Trinity).
Alternative title of *Kuan Yin Tzu* (q.v.).
- Wên Yuan Ying Hua* 文苑英華.
The Brightest Flowers in the Garden of Literature [imperially commissioned collection, intended as a continuation of the *Wên Hsüan* (q.v.) and containing therefore compositions written between +500 and +960].
Sung, +987; first pr. +1567.
Ed. Li Fang 李昉, Sung Pai 宋白 et al.
Cf. des Rotours (2), p. 93.
- Wu Chen Phien* 悟真篇.
[= *Tzu-Yang Chen Jen Wu Chen Phien*.]
Poetical Essay on Realising (the Necessity of Regenerating the) Primary (Vitalities) [Taoist physiological alchemy].
Sung, +1075.
Chang Po-Tuan 張伯端.
In, e.g., *Hsiu Chen Shih Shu* (TT/260), chs. 26-30 incl.
TT/138. Cf. TT/139-43.
Tr. Davis & Chao Yün-Tshung (7).
- Wu Chen Phien Chih Chih Hsiang Shuo San Chhêng Pi Yao* 悟真篇直指詳說三乘秘要.
Precise Explanation of the Difficult Essentials of the *Essay on Realising the Necessity of Regenerating the Primary Vitalities*, in accordance with the Three Classes of (Taoist) Scriptures.
Sung, c. +1170.
Ong Pao-Kuang 翁葆光.
TT/140.
- Wu Chen Phien San Chu* 悟真篇三註.
Three Commentaries on the *Essay on Realising the Necessity of Regenerating the Primary Vitalities* [Taoist physiological alchemy].
Sung and Yuan, completed c. +1331.
Hsüeh Tao-Kuang 薛道光 (or Ong Pao-Kuang 翁葆光), Lu Shu 陸聖 & Tai Chhi-Tsung 戴起宗 (or Chhen Chih-Hsi 陳致虛).
TT/139.
Cf. Davis & Chao Yün-Tshung (7).
- Wu Chhêng Tzu* 務成子.
See *Huang Thing Wai Ching Yü Ching Chu*.
- Wu Chhu Ching* 五廚經.
See *Lao Tzu Shuo Wu Chhu Ching*.
- Wu Hsiang Lei Pi Yao* 五相類秘要.
See *Tshan Thung Chhi Wu Hsiang Lei Pi Yao*.
- Wu Hsing Ta I* 五行大義.
Main Principles of the Five Elements.
Sui, c. +600.
Hsiao Chi 蕭吉.
- Wu Hsüan Phien* 悟玄篇.
Essay on Understanding the Mystery (of the Enchymoma), [Taoist physiological alchemy].
Sung, +1109 or +1169.
Yü Tung-Chen 余洞真.
TT/1034, and in *TTCY* (*shang mao chi*, 5).
- Wu I Chi* 武夷集.
The Wu-I Mountains Literary Collection [prose and poems on physiological alchemy].
Sung, c. +1220.
Ko Chhang-Kêng 葛長庚 (Pai Yü-Chhan 白玉蟾).
In *Hsiu Chen Shih Shu* (TT/260), chs. 45-52.
- Wu Kên Shu* 無根樹.
The Rootless Tree [poems on physiological alchemy].
Ming, c. +1410 (if genuine).
Attrib. Chang San-Fêng 張三峯.
In *San-Fêng Tan Chüeh* (q.v.).
- Wu Lei Hsiang Kan Chih* 物類相感志.
On the Mutual Responses of Things according to their Categories.
Sung, c. +980.
Attrib. wrongly to Su Tung-Pho 蘇東坡.
Actual writer (Lu) Tsan-Ning (monk) 錄贊寧.
See Su Ying-Hui (1, 2).
- Wu Li Hsiao Shih* 物理小識.
Small Encyclopaedia of the Principles of Things.
Ming and Chhing, finished by +1643, pr. +1664.
Fang I-Chih 方以智.
Cf. Hou Wai-Lu (3, 4).

- Wu Lu* 吳錄.
Record of the Kingdom of Wu.
San Kuo, +3rd century.
Chang Pho 張勃.
- Wu Shang Pi Yao* 無上秘要.
Essentials of the Matchless Books (of Taoism), [a florilegium].
N/Chou, between +561 and +578.
Compiler unknown.
TT/1124.
Cf. Maspero (13), p. 77; Schipper (1), p. 11.
- Wu shih Pên Tshao* 吳氏本草.
Mr Wu's Pharmaceutical Natural History.
San Kuo (Wei), c. +235.
Wu Phu 吳普.
Extant only in quotations in later literature.
- Wu Shih Wai Kuo Chuan* 吳時外國傳.
Records of the Foreign Countries in the Time of the State of Wu.
San Kuo, c. +260.
Khang Thai 康泰.
Only in fragments in *TPYL* and other sources.
- Wu Tai Shih Chi*.
See *Hsin Wu Tai Shih*.
- Wu Yuan* 物原.
The Origins of Things.
Ming, +15th.
Lo Chhi 羅頤.
- Yang Hsing Yen Ming Lu* 養性延命錄.
On Delaying Destiny by Nourishing the Natural Forces (or, Achieving Longevity and Immortality by Regaining the Vitality of Youth), [Taoist sexual and respiratory techniques].
Sung, betw. +1013 and +1161 (acc. to Maspero), but as it appears in *YCCC* it must be earlier than +1020, very probably pre-Sung.
Attrib. Thao Hung-Ching or Sun Ssu-Mo.
Actual writer unknown.
TT/831, abridged version in *YCCC*, ch. 32, pp. 1a ff.
Cf. Maspero (7), p. 232.
- Yang Hui Suan Fa* 楊輝算法.
Yang Hui's Methods of Computation.
Sung, +1275.
Yang Hui 楊輝.
- Yang Shêng Shih Chi* 養生食忌.
Nutritional Recommendations and Prohibitions for Health [appended to *Pao Shêng Hsin Chien*, q.v.].
Ming, c. +1506.
Thieh Fêng Chû-Shih 鐵峰居士.
(The Recluse of Iron Mountain, ps.).
Ed. Hu Wên-Huan (c. +1596) 胡文煥.
- Yang Shêng Tao Yin Fa* 養生導引法.
Methods of Nourishing the Vitality by Gymnastics (and Massage), [appended to *Pao Shêng Hsin Chien*, q.v.].
Ming, c. +1506.
- Thieh Fêng Chû-Shih 鐵峰居士.
(The Recluse of Iron Mountain, ps.).
Ed. Hu Wên-Huan (c. +1596) 胡文煥.
- Yang Shêng Thai Hsi Chhi Ching* 養生胎息氣經.
[= *Thai-Shang Yang Shêng Thai Hsi Chhi Ching*.]
Manual of Nourishing the Life-Force (or, Attaining Longevity and Immortality) by Embryonic Respiration.
Late Thang or Sung.
Writer unknown.
TT/812.
Cf. Maspero (7), pp. 358, 365.
- Yang Shêng Yen Ming Lu* 養生延命錄.
On Delaying Destiny by Nourishing the Natural Forces.
Alternative title for *Yang Hsing Yen Ming Lu* (q.v.).
- Yao Chung Chhao* 藥種抄.
Memoir on Several Varieties of Drug Plants.
Japan, shortly before +1156.
Kuan-Yu (Ken-i) 觀祐. MS. preserved at the 滋賀石山寺 Temple. Facsim. reprod. in *Suppl. to the Japanese Tripitaka*, vol. 11.
- Yao Hsing Lun* 藥性論.
Discourse on the Natures and Properties of Drugs.
Liang (or Thang, if identical with *Pên Tshao Yao Hsing*, q.v.).
Attrib. Thao Hung-Ching 陶弘景.
Only extant in quotations in books on pharmaceutical natural history.
ICK, p. 169.
- Yao Hsing Pên Tshao* 藥性本草.
See *Pên Tshao Yao Hsing*.
- Yao Ming Yin Chüeh* 藥名隱訣.
Secret Instructions on the Names of Drugs and Chemicals.
Perhaps an alternative title for the *Thai-Chhing Shih Pi Chi* (q.v.).
- Yeh Chung Chi* 鄒中記.
Record of Affairs at the Capital of the Later Chao Dynasty.
Chin.
Lu Hui 陸翹.
Cf. Hirth (17).
- Yen Fan Lu* 演繁露.
Extension of the *String of Pearls* (on the *Spring and Autumn Annals*), [on the meaning of many Thang and Sung expressions].
Sung, +1180.
Chhêng Ta-Chhang 程大昌.
See des Rotours (1), p. cix.
- Yen Hsien Chhing Shang Chien* 燕閒清賞箋.
The Use of Leisure and Innocent Enjoyments in a Retired Life [the sixth part (chs. 14, 15) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高濂.

- Yen I I Mou Lu* 燕翼詒謀錄.
Handing Down Good Plans for Posterity from the Wings of Yen.
Sung, +1227.
Wang Yung 王祐.
Yen-Ling hsien-seng Chi Hsin Chiu Fu Chhi Ching 延陵先生集新舊服氣經.
New and Old Manuals of Absorbing the Chhi, Collected by the Teacher of Yen-Ling.
Thang, early +8th, c. +745.
Writer unidentified.
Comm. by Sang Yü Tzu (+9th or +10th) 桑榆子.
TT/818, and (partially) in YCCC, ch. 58, p. 2a et passim, ch. 59, pp. 1a ff., 18b ff., ch. 61, pp. 19a ff.
Cf. Maspero (7), pp. 220, 222.
- Yen Mên Kung Miao Chieh Lu* 鴈門公妙解錄.
The Venerable Yen Mên's Record of Marvelous Antidotes [alchemy and elixir poisoning].
Thang, probably in the neighbourhood of +847 since the text is substantially identical with the *Hsüan Chieh Lu* (q.v.) of this date.
Yen Mên 鴈門 (perhaps a ps. taken from the pass and fortress on the Great Wall, cf. Vol. 4, pt. 3, pp. 11, 48 and Fig. 711).
TT/937.
- Yen Nien Chhio Ping Chien* 延年却病錢.
How to Lengthen one's Years and Ward off all Diseases [the fourth part (chs. 9, 10) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高謙.
Partial tr. of the gymnastic material, Dudgeon (1).
- Yen Shou Chhü Shu* 延壽赤書.
Red Book on the Promotion of Longevity.
Thang, perhaps Sui.
Phei Yü (or Hsüan) 裴煜 (玄).
Extant only in excerpts preserved in the *I Hsin Fang* (+982), SIC, p. 465.
- Yen Thieh Lun* 鹽鐵論.
Discourses on Salt and Iron [record of the debate of -81 on State control of commerce and industry].
C/Han, c. -80 to -60.
Huan Khuan 桓寬.
Partial tr. Gale (1); Gale, Boodberg & Lin.
- Yin Chen Chin Chin Shih Wu Hsiang Lei* 陰眞君金石五相類.
Alternative title of *Chin Shih Wu Hsiang Lei* (q.v.).
- Yin Chen Jen Liao Yang Tien Wen Ta Pien* 尹真人寥陽殿問答編.
See *Liao Yang Tien Wen Ta Pien*.
- Yin Chen Jen Tung-Hua Chêng Mo Huang Chi* 尹真人東華正脈皇極圖證道仙經.
See *Huang Chi Ho Pi Hsien Ching*.
- Yin Chuan Fu Shih Chien* 飲餌服食錢.
Explanations on Diet, Nutrition and Clothing [the fifth part (chs. 11-13) of *Tsun Shêng Pa Chien*, q.v.].
Ming, +1591.
Kao Lien 高謙.
- Yin Fu Ching* 陰符經.
The Harmony of the Seen and the Unseen.
Thang, c. +735 (unless in essence a preserved late Warring States document).
Li Chhüan 李筌.
TT/30.
Cf. TT/105-124. Also in *TTCY* (*tau chi*, 6).
Tr. Legge (5).
Cf. Maspero (7), p. 222.
- Yin Shan Chêng Yao* 飲膳正要.
Principles of Correct Diet [on deficiency diseases, with the aphorism 'many diseases can be cured by diet alone'].
Yuan, +1330, re-issued by imperial order in +1456.
Hu Ssu-Hui 忽思慧.
See Lu & Needham (1).
- Yin Tan Nei Phien* 陰丹內篇.
Esoteric Essay on the Yin Enchymoma. Appendix to the *Tho Yo Tzu* (q.v.).
- Yin-Yang Chiu Chuan Chhêng Tzu-Chin Tien-Hua Huan Tan Chhüeh* 陰陽九轉成紫金點化還丹訣.
Secret of the Cyclically Transformed Elixir, Treated through Nine Yin-Yang Cycles to Form Purple Gold and Projected to Bring about Transformation.
Date unknown.
Writer unknown, but someone with Mao Shan affiliations.
TT/888.
- Ying Chhan Tzu Yü Lu* 螢蟾子語錄.
Collected Discourses of the Luminous-Toad Master.
Yuan, c. +1320.
Li Tao-Shun 李道純 (Ying Chhan Tzu 螢蟾子).
TT/1047.
- Ying Yai Shêng Lan* 瀛涯勝覽.
Triumphant Visions of the Ocean Shores [relative to the voyages of Chêng Ho].
Ming, +1451. (Begun +1416 and completed about +1435.)
Ma Huan 馬歡.
Tr. Mills (11); Groeneveldt (1); Phillips (1); Duyvendak (10).
- Ying Yai Shêng Lan Chi* 瀛涯勝覽集.
Abstract of the *Triumphant Visions of the Ocean Shores* [a refacimento of Ma Huan's book].
Ming, +1522.
Chang Shêng (b) 張昇.
Passages cit. in *TSCC*, *Pien i tien*, chs. 58, 73, 78, 85, 86, 96, 97, 98, 99, 101, 103, 106.
Tr. Rockhill (1).

- Yojōkun* 養生訓.
Instructions on Hygiene and the Prolongation of Life.
Japan (Tokugawa), c. +1700.
Kaibara Ekiken 貝原益軒 (ed. Sugiyasu Saburō 杉端三郎).
- Yü-Chhing Chin-Ssu Chhing-Hua Pi-Wên Chin-Pao Nei-Lien Tan Chüeh* 玉清金笥青華祕文金寶內錄丹訣.
The Green-and-Elegant Secret Papers in the Jade-Purity Golden Box on the Essentials of the Internal Refining of the Golden Treasure, the Enchymoma.
Sung, late +11th century.
Chang Po-Tuan 張伯端.
TT/237.
Cf. Davis & Chao Yün-Tshung (5).
- Yü-Chhing Nei Shu* 玉清內書.
Inner Writings of the Jade-Purity (Heaven).
Probably Sung, but present version incomplete, and some of the material may be, or may have been, older.
Compiler unknown.
TT/940.
- Yü Fang Chih Yao* 玉房指要.
Important Matters of the Jade Chamber.
Pre-Sui, perhaps +4th century.
Writer unknown.
In *I Hsin Fang* (Ishinhō) and *Shuang Mei Ching An Tshung Shu*.
Partial trs. van Gulik (3, 8).
- Yü Fang Pi Chüeh* 玉房祕訣.
Secret Instructions concerning the Jade Chamber.
Pre-Sui, perhaps +4th century.
Writer unknown.
Partial tr. van Gulik (3).
Only as fragment in *Shuang Mei Ching An Tshung Shu* (q.v.).
- Yu Huan Chi Wên* 游宦紀聞.
Things Seen and Heard on my official Travels.
Sung, +1233.
Chang Shih-Nan 張世南.
- Yü Phien* 玉篇.
Jade Page Dictionary.
Liang, +543.
Ku Yeh-Wang 顧野王.
Extended and edited in the Thang (+674) by Sun Chhiang 孫愬.
- Yü Shih Ming Yen* 喻世明言.
Stories to Enlighten Men.
Ming, c. +1640.
Feng Meng-Lung 馮夢龍.
- Yü Tung Ta Shen Tan Sha Chen Yao Chüeh* 玉洞大神丹砂真要訣.
True and Essential Teachings about the Great Magical Cinnabar of the Jade Heaven [paraphrase of +8th-century materials].
Thang, not before +8th.
Attrib. Chang Kuo 張果.
TT/889.
- Yu-Yang Tsa Tsu* 酉陽雜俎.
Miscellany of the Yu-yang Mountain (Cave) [in S.E. Szechuan].
Thang, +863.
Tuan Chhêng-Shih 段成式.
See des Rotours (1), p. civ.
- Yuan Chhi Lun* 元氣論.
Discourse on the Primary Vitality (and the Cosmogonic Chhi).
Thang, late +8th or perhaps +9th.
Writer unknown.
In YCCC, ch. 56.
Cf. Maspero (7), p. 207.
- Yuan-Shih Shang Chen Chung Hsien Chi* 元始上真衆仙記.
Record of the Assemblies of the Perfected Immortals; a Yuan-Shih Scripture.
Ascr. Chin, c. +320, more probably +5th or +6th.
Attrib. Ko Hung 葛洪.
TT/163.
- Yuan Yang Ching* 元陽經.
Manual of the Primary Yang (Vitality).
Chin, L/Sung, Chhi or Liang, before +550.
Writer unknown.
Extant only in quotations, in *Yang Hsing Yen Ming Lu*, etc.
Cf. Maspero (7), p. 232.
- Yuan Yu* 遠遊.
Roaming the Universe; or, The Journey into Remoteness [ode].
C/Han, c. -110.
Writer's name unknown, but a Taoist.
Tr. Hawkes (1).
- Yüeh Wei Tshao Thang Pi Chi* 閱微草堂筆記.
Jottings from the Yüeh-wei Cottage.
Chhing, 1800.
Chi Yün 紀昀.
- Yün Chai Kuang Lu* 雲齋廣錄.
Extended Records of the Cloudy Studio.
Sung.
Li Hsien-Min 李獻民.
- Yün Chhi Yu I* 雲溪友議.
Discussions with Friends at Cloudy Pool.
Thang, c. +870.
Fan Shu 范攄.
- Yün Chi Chhi Chhien* 雲笈七籤.
The Seven Bamboo Tablets of the Cloudy Satchel [an important collection of Taoist material made by the editor of the first definitive form of the *Tao Tsang* (+1019), and including much material which is not in the Patrology as we now have it].
Sung, c. +1022.
Chang Chün-Fang 張君房.
TT/1020.
- Yün Hsien Tsa Chi* 雲仙雜記.
Miscellaneous Records of the Cloudy Immortals.
Thang or Wu Tai, c. +904.
Feng Chih 馮贇.

Yün Hsien San Lu 雲仙散錄.

Scattered Remains on the Cloudy Immortals.

Ascr. Thang or Wu Tai, c. +904, actually probably Sung.

Attrib. Fêng Chih 馮贇, but probably by Wang Chih 王銍.

Yün Kuang Chi 雲光集.

Collected (Poems) of Light (through the) Clouds.

Sung, c. +1170.

Wang Chhu-I 王處一.

TT/1138.

CONCORDANCE FOR TAO TSANG BOOKS AND TRACTATES

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989 (<i>Ku Wên</i>) <i>Lung Hu Shang Ching</i> <i>Chu</i>	995	1125 <i>San Tung Chu Nang</i>	1131
990 <i>Chou I Tshan Thung Chhi</i> (<i>Chu</i>) comm. by Yin Chhang-Shêng	996	1127 <i>Hsien Lo Chi</i>	1133
991 <i>Chou I Tshan Thung Chhi Chu</i> comm. anon.	997	1128 <i>Chien Wu Chi</i>	1134
992 <i>Tshan Thung Chhi Khao I</i> (or <i>Chou I Tshan Thung Chhi Chu</i>) comm. by Chu Hsi	998	1130 <i>Tzu-Jan Chi</i>	1136
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994 <i>Chou I Tshan Thung Chhi Ting Chhi</i> <i>Ko Ming Ching Thu</i> comm. by Phêng Hsiao	1000	1136 <i>Tan-Yang Shen Kuang Tshan</i>	1142
995 <i>Chou I Tshan Thung Chhi Chu</i> comm. anon.	1001	1138 <i>Yün Kuang Chi</i>	1144
996 <i>Chou I Tshan Thung Chhi Fa Hui</i> comm. by Yü Yen	1002	1139 (<i>Wang</i>) <i>Chhung-Yang Chhüan Chen</i> <i>Chi</i>	1145
997 <i>Chou I Tshan Thung Chhi Shih I</i> comm. by Yü Yen	1003	1140 (<i>Wang</i>) <i>Chhung-Yang Chiao Hua</i> <i>Chi</i>	1146
998 <i>Chou I Tshan Thung Chhi Chieh</i> comm. by Chhen Hsien-Wei	1004	1141 (<i>Wang</i>) <i>Chhung-Yang Fên-Li</i> <i>Shih-Hua Chi</i>	1147
999 <i>Chou I Tshan Thung Chhi Chu</i> comm. by Chhu Hua-Ku	1005	1142 (<i>Wang</i>) <i>Chhung-Yang (Chen Jen)</i> <i>Chin-Kuan</i> (or <i>Chhüeh</i>) <i>Yü-So</i> <i>Chüeh</i>	1148
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1005 <i>Tao Shu</i>	1011	1146 <i>Than hsien-sêng Shui Yün Chi</i>	1152
1020 <i>Yün Chi Chhi Chhien</i>	1026	1147 <i>Thai-Ku Chi</i>	1153
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1028 <i>Huang Chi Ching Shih (Shu)</i>	1034	1171 <i>Pao Phu Tzu, Nei Phien</i>	1177
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1058 <i>Chin Tan Chih Chih</i>	1064	1212 <i>Chhüan-Chen Tso Po Chieh Fa</i>	1219
1067 <i>Chin Tan Ssu Pai Tzu (Chu)</i>	1073	1216 (<i>Wang</i>) <i>Chhung-Yang Li-Chiao</i> <i>Shih-Wu Lun</i>	1223
1068 <i>Lung Hu Huan Tan Chüeh Sung</i>	1074	1225 <i>Chêng I Fa Wên (Thai-Shang)</i> <i>Wai Lu I</i>	1233
1074 <i>Huan Tan Fu Ming Phien</i>	1080	1235 <i>Tao Fa Hsin Chhuan</i>	1243
1076 <i>Tshui Hsü Phien</i>	1082	1273 <i>Shang-Chhing Ching Pi Chüeh</i>	1281
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GENERAL INDEX

by MURIEL MOYLE

NOTES

- (1) Articles (such as 'the', 'al-', etc.) occurring at the beginning of an entry, and prefixes (such as 'de', 'van', etc.) are ignored in the alphabetical sequence. Saints appear among all letters of the alphabet according to their proper names. Styles such as Mr, Dr, if occurring in book titles or phrases, are ignored; if with proper names, printed following them.
- (2) The various parts of hyphenated words are treated as separate words in the alphabetical sequence. It should be remembered that, in accordance with the conventions adopted, some Chinese proper names are written as separate syllables while others are written as one word.
- (3) In the arrangement of Chinese words, Chh- and Hs- follow normal alphabetical sequence, and *ü* is treated as equivalent to *u*.
- (4) References to footnotes are not given except for certain special subjects with which the text does not deal. They are indicated by brackets containing the superscript letter of the footnote.
- (5) Explanatory words in brackets indicating fields of work are added for Chinese scientific and technological persons (and occasionally for some of other cultures), but not for political or military figures (except kings and princes).

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周	CHOU dynasty (Feudal Age)	<table><tr><td>{</td><td>Early Chou period</td><td>c. -1030 to -722</td></tr><tr><td>{</td><td>Chhun Chhiu period 春秋</td><td>-722 to -480</td></tr><tr><td>{</td><td>Warring States (Chan Kuo) period 戰國</td><td>-480 to -221</td></tr></table>	{	Early Chou period	c. -1030 to -722	{	Chhun Chhiu period 春秋	-722 to -480	{	Warring States (Chan Kuo) period 戰國	-480 to -221
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First Unification	秦 CHHIN dynasty	-221 to -207									
漢	HAN dynasty	<table><tr><td>{</td><td>Chhien Han (Earlier or Western)</td><td>-202 to +9</td></tr><tr><td>{</td><td>Hsin interregnum</td><td>+9 to +23</td></tr><tr><td>{</td><td>Hou Han (Later or Eastern)</td><td>+25 to +220</td></tr></table>	{	Chhien Han (Earlier or Western)	-202 to +9	{	Hsin interregnum	+9 to +23	{	Hou Han (Later or Eastern)	+25 to +220
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{	Hsin interregnum	+9 to +23									
{	Hou Han (Later or Eastern)	+25 to +220									
三國	SAN KUO (Three Kingdoms period)	+221 to +265									
First Partition	蜀 SHU (HAN)	+221 to +264									
	魏 WEI	+220 to +265									
	吳 WU	+222 to +280									
Second Unification	晉 CHIN dynasty: Western	+265 to +317									
	Eastern	+317 to +420									
劉宋	(Liu) SUNG dynasty	+420 to +479									
Second Partition	Northern and Southern Dynasties (Nan Pei chhao)										
	齊 CHHI dynasty	+479 to +502									
	梁 LIANG dynasty	+502 to +557									
	陳 CHHEN dynasty	+557 to +589									
	魏 {	<table><tr><td>{</td><td>Northern (Thopa) WEI dynasty</td><td>+386 to +535</td></tr><tr><td>{</td><td>Western (Thopa) WEI dynasty</td><td>+535 to +556</td></tr><tr><td>{</td><td>Eastern (Thopa) WEI dynasty</td><td>+534 to +550</td></tr></table>	{	Northern (Thopa) WEI dynasty	+386 to +535	{	Western (Thopa) WEI dynasty	+535 to +556	{	Eastern (Thopa) WEI dynasty	+534 to +550
{	Northern (Thopa) WEI dynasty	+386 to +535									
{	Western (Thopa) WEI dynasty	+535 to +556									
{	Eastern (Thopa) WEI dynasty	+534 to +550									
	北齊 Northern CHHI dynasty	+550 to +577									
	北周 Northern CHOU (Hsienpi) dynasty	+557 to +581									
Third Unification	隋 SUI dynasty	+581 to +618									
	唐 THANG dynasty	+618 to +906									
Third Partition	五代 WU TAI (Five Dynasty period) (Later Liang, Later Thang (Turkic), Later Chin (Turkic), Later Han (Turkic) and Later Chou)	+907 to +960									
	遼 LIAO (Chhitan Tartar) dynasty	+907 to +1124									
	West LIAO dynasty (Qarā-Khiṭāi)	+1124 to +1211									
	西夏 Hsi Hsia (Tangut Tibetan) state	+986 to +1227									
Fourth Unification	宋 Northern SUNG dynasty	+960 to +1126									
	宋 Southern SUNG dynasty	+1127 to +1279									
	金 CHIN (Jurchen Tartar) dynasty	+1115 to +1234									
	元 YUAN (Mongol) dynasty	+1260 to +1368									
	明 MING dynasty	+1368 to +1644									
	清 CHHING (Manchu) dynasty	+1644 to +1911									
民國	Republic	+1912									

N.B. When no modifying term in brackets is given, the dynasty was purely Chinese. Where the overlapping of dynasties and independent states becomes particularly confused, the tables of Wiegner (1) will be found useful. For such periods, especially the Second and Third Partitions, the best guide is Eberhard (9). During the Eastern Chin period there were no less than eighteen independent States (Hunnish, Tibetan, Hsienpi, Turkic, etc.) in the north. The term 'Liu chhao' (Six Dynasties) is often used by historians of literature. It refers to the south and covers the period from the beginning of the +3rd to the end of the +6th centuries, including (San Kuo) Wu, Chin, (Liu) Sung, Chhi, Liang and Chhen. For all details of reigns and rulers see Moule & Yetts (1).

ROMANISATION CONVERSION TABLES

BY ROBIN BRILLIANT

PINYIN/MODIFIED WADE-GILES

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
a	a	chou	chhou
ai	ai	chu	chhu
an	an	chuai	chhuai
ang	ang	chuan	chhuan
ao	ao	chuang	chhuang
ba	pa	chui	chhui
bai	pai	chun	chhun
ban	pan	chuo	chho
bang	pang	ci	tzhu
bao	pao	cong	tshung
bei	pei	cou	tshou
ben	pen	cu	tshu
beng	peng	cuan	tshuan
bi	pi	cui	tshui
bian	pian	cun	tshun
biao	piao	cuo	tsho
bie	pieh	da	ta
bin	pin	dai	tai
bing	ping	dan	tan
bo	po	dang	tang
bu	pu	dao	tao
ca	tsha	de	te
cai	tshai	dei	tei
can	tshan	den	ten
cang	tshang	deng	teng
cao	tshao	di	ti
ce	tshe	dian	tien
cen	tshen	diao	tiao
ceng	tsheng	die	dieh
cha	chha	ding	ting
chai	chhai	diu	tiu
chan	chhan	dong	tung
chang	chhang	dou	tou
chao	chhao	du	tu
che	chhe	duan	tuan
chen	chhen	dui	tui
cheng	chheng	dun	tun
chi	chhih	duo	to
chong	chhung	e	e, o

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
en	en	jia	chia
eng	eng	jian	chien
er	erh	jiang	chiang
fa	fa	jiao	chiao
fan	fan	jie	chieh
fang	fang	jin	chin
fei	fei	jing	ching
fen	fen	jiong	chiung
feng	feng	jiu	chiu
fo	fo	ju	chŭ
fou	fou	juan	chüan
fu	fu	jue	chüeh, chio
ga	ka	jun	chün
gai	kai	ka	kha
gan	kan	kai	khai
gang	kang	kan	khan
gao	kao	kang	khang
ge	ko	kao	khao
gei	kei	ke	kho
gen	ken	kei	khei
geng	keng	ken	khen
gong	kung	keng	kheng
gou	kou	kong	khung
gu	ku	kou	khou
gua	kua	ku	khu
guai	kuai	kua	khua
guan	kuan	kuai	khuai
guang	kuang	kuan	khuan
gui	kuei	kuang	khuang
gun	kun	kui	khuei
guo	kuo	kun	khun
ha	ha	kuo	khuo
hai	hai	la	la
han	han	lai	lai
hang	hang	lan	lan
hao	hao	lang	lang
he	ho	lao	lao
hei	hei	le	le
hen	hen	lei	lei
heng	heng	leng	leng
hong	hung	li	li
hou	hou	lia	lia
hu	hu	lian	lien
hua	hua	liang	liang
huai	huai	liao	liao
huan	huan	lie	lieh
huang	huang	lin	lin
hui	hui	ling	ling
hun	hun	liu	liu
huo	huo	lo	lo
ji	chi	long	lung

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
lou	lou	pa	pha
lu	lu	pai	phai
lǔ	lǔ	pan	phan
luan	luan	pang	phang
lǜe	lǜeh	pao	phao
lun	lun	pei	phei
luo	lo	pen	phen
ma	ma	peng	pheng
mai	mai	pi	phi
man	man	pian	phien
mang	mang	piao	phiao
mao	mao	pie	phieh
mei	mei	pin	phin
men	men	píng	phing
meng	meng	po	pho
mi	mi	pou	phou
mian	mien	pu	phu
miao	miao	qi	chhi
mie	mieh	qia	chhia
min	min	qian	chhien
ming	ming	qiang	chhiang
miu	miu	qiao	chhiao
mo	mo	qie	chhieh
mou	mou	qin	chhin
mu	mu	qing	chhing
na	na	qiong	chhiung
nai	nai	qiu	chhiu
nan	nan	qu	chhü
nang	nang	quan	chhüan
nao	nao	que	chhüeh, chhio
nei	nei	qun	chhün
nen	nen	ran	jan
neng	neng	rang	jang
ng	ng	rao	jao
ni	ni	re	je
nian	nien	ren	jen
niang	niang	reng	jeng
niao	niao	ri	jih
nie	nieh	rong	jung
nin	nin	rou	jou
ning	ning	ru	ju
niu	niu	rua	jua
nong	nung	ruan	juan
nou	nou	rui	jui
nu	nu	run	jun
nǔ	nǔ	ruo	jo
nuan	nuan	sa	sa
nǜe	nio	sai	sai
nuo	no	san	san
o	o, e	sang	sang
ou	ou	sao	sao

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
se	se	wan	wan
sen	sen	wang	wang
seng	seng	wei	wei
sha	sha	wen	wen
shai	shai	weng	ong
shan	shan	wo	wo
shang	shang	wu	wu
shao	shao	xi	hsi
she	she	xia	hsia
shei	shei	xian	hsien
shen	shen	xiang	hsiang
sheng	sheng, seng	xiao	hsiao
shi	shih	xie	hsieh
shou	shou	xin	hsin
shu	shu	xing	hsing
shua	shua	xiong	hsiung
shuai	shuai	xiu	hsiu
shuan	shuan	xu	hsü
shuang	shuang	xuan	hsüan
shui	shui	xue	hsüeh, hsio
shun	shun	xun	hsün
shuo	shuo	ya	ya
si	ssu	yan	yen
song	sung	yang	yang
sou	sou	yao	yao
su	su	ye	yeh
suan	suan	yi	i
sui	sui	yin	yin
sun	sun	ying	ying
suo	so	yo	yo
ta	tha	yong	yung
tai	thai	you	yu
tan	than	yu	yü
tang	thang	yuan	yüan
tao	thao	yue	yüeh, yo
te	the	yun	yün
teng	theng	za	tsa
ti	thi	zai	tsai
tian	thien	zan	tsan
tiao	thiao	zang	tsang
tie	thieh	zao	tsao
ting	thing	ze	tse
tong	thung	zei	tsei
tou	thou	zen	tsen
tu	thu	zeng	tseng
tuan	thuan	zha	cha
tui	thui	zhai	chai
tun	thun	zhan	chan
tuo	tho	zhang	chang
wa	wa	zhao	chao
wai	wai	zhe	che

Pinyin	Modified Wade-Giles	Pinyin	Modified Wade-Giles
zhei	chei	zhui	chui
zhen	chen	zhun	chun
zheng	cheng	zhuo	cho
zhi	chih	zi	tzu
zhong	chung	zong	tsung
zhou	chou	zou	tsou
zhu	chu	zu	tsu
zhua	chua	zuan	tsuan
zhuai	chuai	zui	tsui
zhuan	chuan	zun	tsun
zhuang	chuang	zuo	tso

MODIFIED WADE-GILES/PINYIN

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
a	a	chhio	que
ai	ai	chhiu	qiu
an	an	chhiung	qiong
ang	ang	chho	chuo
ao	ao	chhou	chou
cha	zha	chhu	chu
chai	chai	chhuai	chuai
chan	zhan	chhuan	chuan
chang	zhang	chhuang	chuang
chao	zhao	chhui	chui
che	zhe	chhun	chun
chei	zhei	chhung	chong
chen	zhen	chhü	qu
cheng	zheng	chhüan	quan
chha	cha	chhüeh	que
chhai	chai	chhün	qun
chhan	chan	chi	ji
chhang	chang	chia	jia
chhao	chao	chiang	jiang
chhe	che	chiao	jiao
chhen	chen	chieh	jie
chheng	cheng	chien	jian
chhi	qi	chih	zhi
chhia	qia	chín	jín
chhiang	qiang	ching	jing
chhiao	qiao	chio	jue
chhieh	qie	chiu	jiu
chhien	qian	chiung	jiong
chhih	chi	cho	zhuo
chhin	qin	chou	zhou
chhing	qing	chu	zhu

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
chua	zhua	huan	huan
chuai	zhuai	huang	huang
chuan	zhuan	hui	hui
chuang	zhuang	hun	hun
chui	zhui	hung	hong
chun	zhun	huo	huo
chung	zhong	i	yi
chü	ju	jan	ran
chüan	juan	jang	rang
chüeh	jue	jao	rao
chün	jun	je	re
e	e, o	jen	ren
en	en	jeng	reng
eng	eng	jih	ri
erh	er	jo	ruo
fa	fa	jou	rou
fan	fan	ju	ru
fang	fang	jua	rua
fei	fei	juan	ruan
fen	fen	jui	rui
feng	feng	jun	run
fo	fo	jung	rong
fou	fou	ka	ga
fu	fu	kai	gai
ha	ha	kan	gan
hai	hai	kang	gang
han	han	kao	gao
hang	hang	kei	gei
hao	hao	ken	gen
hen	hen	keng	geng
heng	heng	kha	ka
ho	he	khai	kai
hou	hou	khan	kan
hsi	xi	khang	kang
hsia	xia	khao	kao
hsiang	xiang	khei	kei
hsiao	xiao	khen	ken
hsieh	xie	kheng	keng
hsien	xian	kho	ke
hsin	xin	khou	kou
hsing	xing	khu	ku
hsio	xue	khua	kua
hsiu	xiu	khuai	kuai
hsiung	xiong	khuan	kuan
hsü	xu	khuang	kuang
hsüan	xuan	khuei	kui
hsüeh	xue	khun	kun
hsün	xun	khung	kong
hu	hu	khuo	kuo
hua	hua	ko	ge
huai	huai	kou	gou

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
ku	gu	mu	mu
kua	gua	na	na
kuai	guai	nai	nai
kuan	guan	nan	nan
kuang	guang	nang	nang
kuei	gui	nao	nao
kun	gun	nei	nei
kung	gong	nen	nen
kuo	guo	neng	neng
la	la	ni	ni
lai	lai	niang	niang
lan	lan	niao	niao
lang	lang	nieh	nie
lao	lao	nien	nian
le	le	nin	nin
lei	lei	ning	ning
leng	leng	niu	nüe
li	li	niu	niu
lia	lia	no	nuo
liang	liang	nou	nou
liao	liao	nu	nu
lieh	lie	nuan	nuan
lien	lian	nung	nong
lin	lin	nü	nü
ling	ling	o	e, o
liu	liu	ong	weng
lo	luo, lo	ou	ou
lou	lou	pa	ba
lu	lu	pai	bai
luan	luan	pan	ban
lun	lun	pang	bang
lung	long	pao	bao
lŭ	lŭ	pei	bei
lŭeh	lŭe	pen	ben
ma	ma	peng	beng
mai	mai	pha	pa
man	man	phai	pai
mang	mang	phan	pan
mao	mao	phang	pang
mei	mei	phao	pao
men	men	phei	pei
meng	meng	phen	pen
mi	mi	pheng	peng
miao	miao	phi	pi
mieh	mie	phiao	piao
mien	mian	phieh	pie
min	min	phien	pian
ming	ming	phin	pin
miu	miu	phing	ping
mo	mo	pho	po
mou	mou	phou	pou

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
phu	pu	ten	den
pi	bi	teng	deng
piao	biao	tha	ta
pieh	bie	thai	tai
pien	bian	than	tan
pin	bin	thang	tang
ping	bing	thao	tao
po	bo	the	te
pu	bu	theng	teng
sa	sa	thi	ti
sai	sai	thiao	tiao
san	san	thieh	tie
sang	sang	thien	tian
sao	sao	thing	ting
se	se	tho	tuo
sen	sen	thou	tou
seng	seng, sheng	thu	tu
sha	sha	thuan	tuan
shai	shai	thui	tui
shan	shan	thun	tun
shang	shang	thung	tong
shao	shao	ti	di
she	she	tiao	diao
shei	shei	tieh	die
shen	shen	tien	dian
sheng	sheng	ting	ding
shih	shi	tiu	diu
shou	shou	to	duo
shu	shu	tou	dou
shua	shua	tsa	za
shuai	shuai	tsai	zai
shuan	shuan	tsan	zan
shuang	shuang	tsang	zang
shui	shui	tsao	zao
shun	shun	tse	ze
shuo	shuo	tsei	zei
so	suo	tsen	zen
sou	sou	tseng	zeng
ssu	si	tsha	ca
su	su	tshai	cai
suan	suan	tshan	can
sui	sui	tshang	cang
sun	sun	tshao	cao
sung	song	tshe	ce
ta	da	tshen	cen
tai	dai	tsheng	ceng
tan	dan	tsho	cuo
tang	dang	tshou	cou
tao	dao	tshu	cu
te	de	tshuan	cuan
tei	dei	tshui	cui

Modified Wade-Giles	Pinyin	Modified Wade-Giles	Pinyin
tshun	cun	wang	wang
tshung	cong	wei	wei
tso	zuo	wen	wen
tsou	zou	wo	wo
tsu	zu	wu	wu
tsuan	zuan	ya	ya
tsui	zui	yang	yang
tsun	zun	yao	yao
tsung	zong	yeh	ye
tu	du	yen	yan
tuan	duan	yin	yin
tui	dui	ying	ying
tun	dun	yo	yue, yo
tung	dong	yu	you
tzhu	ci	yung	yong
tzu	zi	yü	yu
wa	wa	yüan	yuan
wai	wai	yüeh	yue
wan	wan	yün	yun